ENGINEERING NEWS-RECORD

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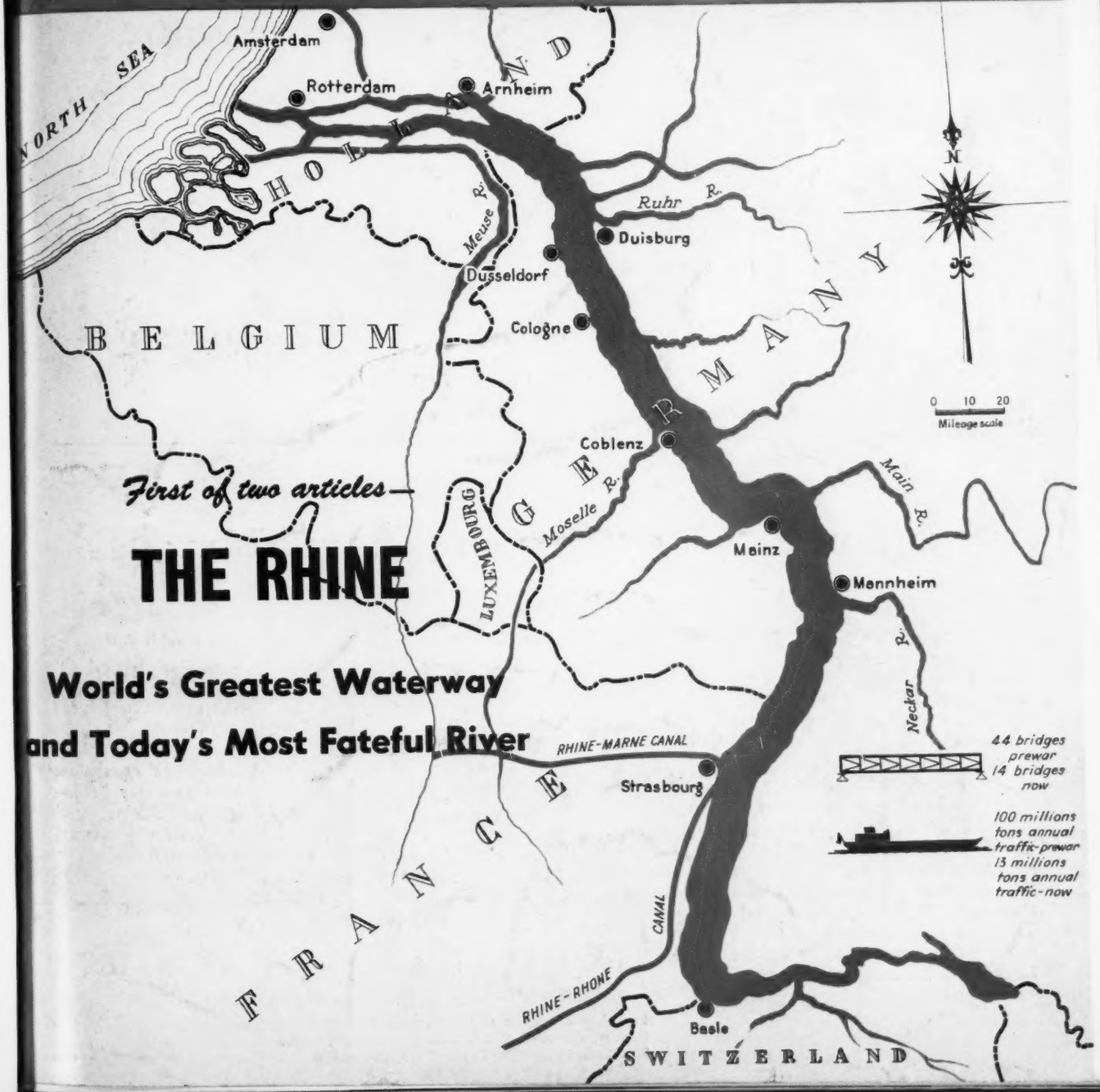
OCTOBER 16, 1947



First of two articles—

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Volume 139 • Number 16

OCTOBER 16, 1947

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Construction Trends

Construction Volume Turns Up, Now 2% Ahead of a Year Ago

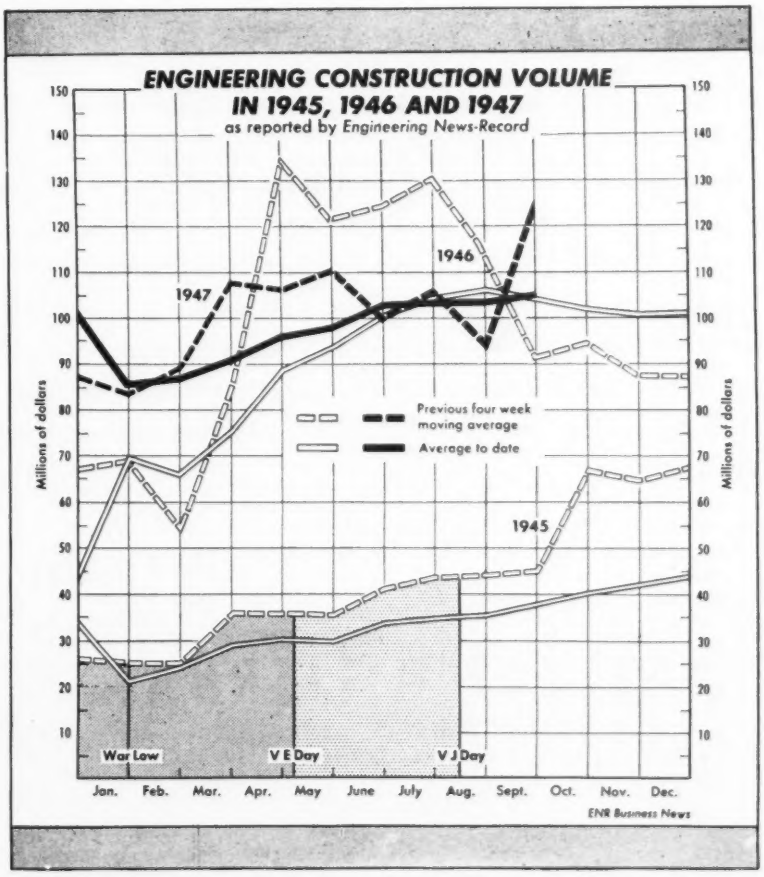
The four-weeks moving average of the volume of heavy engineering construction contract awards, as recorded by *Engineering News-Record*, rose to a new monthly high of $124,141,00 in September, this year, or 12.3 percent above the previous 1947 monthly high reached at the end of May. As compared with the postwar period, the four-weeks moving average at the end of September, 1947 was topped only in April, June and July last year when the averages reached $134,877,000, $124,680,000 and $131,086,000, respectively.

Compared with September, 1946, when the moving average dropped to $92,222,000 from $115,355,000 at the end of August, the four-weeks moving average at the end of September this year showed a rise of 34.6 percent. September this year was the first time since the end of March that the moving average rose above the corresponding month a year ago.

The dollar volume of construction contract awards for the average week in the January through September, 1947 period rose to $105,292,000, or 1.2 percent above the corresponding average of $104,074,000 a year ago. The second week of October, however, brought the average week to date to $106,493,000, or 1.1 percent above the September average.

The cumulative total of construction contract awards through the end of September, 1947 amounted to $41,160,402,000, a gain of $47,505,000, or 1.2 percent over the cumulative total through September, 1946. Weekly construction contract volume has been running consistently ahead of a year ago since mid-August, except for the week ended September 18. The cumulative total of construction contract awards through the second week of October rose to $41,366,197,000, or 2.1 percent over the corresponding period last year.

Private contract awards amounted to $2,320,313,000 from January through September, 1947 and $2,495,393,000 from January through October 9, 1947. These totals were 6.6 and 3.7 percent, respectively, below the corresponding 1946 totals as against a decline of 10.5 percent at the end of August, 1947 below the August, 1946 cumulative total. Private contract awards have thus been accumulating at a faster rate during September and October this year than a year ago.



The cumulative total of public construction contract awards, amounting to $2,495,373,000 through the second week of October is 11.1 percent ahead of a year ago. At the end of September, the volume of public construction contract awards was 13.4 percent ahead of corresponding period of 1946.

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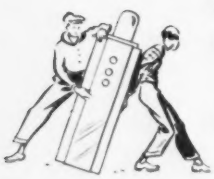

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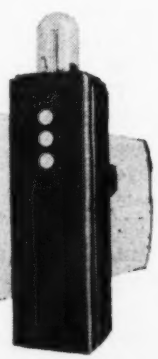

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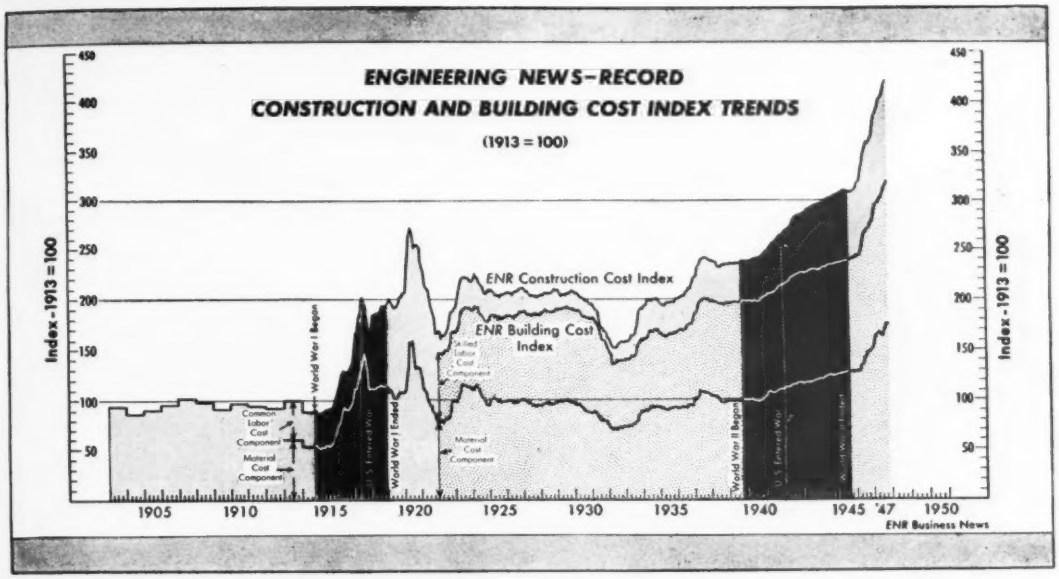
OCTOBER CONSTRUCTION BUSINESS REPORT



ENR CONSTRUCTION VOLUME AND NEW PRODUCTIVE CAPITAL

Thousands of Dollars (,000 omitted)	September 1946 (4 wk.)	September 1947 (4 wk.)	% Change	Nine Months 1946 (39 wk.)	Nine Months 1947 (39 wk.)	% Change
Total U. S. Construction	$373,056	$494,805	+33	$4,058,897	$4,106,402	+1
Private Construction	229,622	301,785	+31	2,484,195	2,320,313	−7
Public Construction	143,434	193,020	+35	1,574,702	1,786,089	+13
Federal	25,368	40,041	+58	515,853	493,114	−4
E N R Construction Volume Index, 1913 = 100	223	255	+14	264	228	−14
Total New Productive Capital	42,635	150,578	+253	2,881,859	2,518,971	−13
Private Investment	42,635	150,578	+253	942,164	1,452,531	+54
Federal (non-federal work)	.....	.....	.....	225,000	247,711	+10
Federal (federal work)	.....	.....	.....	1,714,695	818,729	−52

ENR INDEX NUMBERS

Base = 100	Construction Cost 1913	Construction Cost 1926	Building Cost 1913	Building Cost 1926	Volume '13	Volume '26
Oct., 1947	424.41	204.01	320.58	173.30	...	...
Sept., 1947	417.81	200.84	317.08	171.40	255	112
Aug., 1947	415.00	199.49	313.03	169.21	215	94
July, 1947	406.52	195.41	304.87	164.80	222	97
June, 1947	403.29	193.86	303.14	163.87	276	121
May, 1947	396.49	190.59	299.61	161.96	224	98
Apr., 1947	396.09	190.40	300.81	162.61	247	108
Mar., 1947	391.95	188.41	298.84	161.54	220	96
Feb., 1947	390.76	187.84	297.65	160.90	197	86
Jan., 1947	381.68	183.47	289.05	156.25	195	86
Dec., 1946	368.10	176.95	278.77	150.69	207	91
Nov., 1946	362.47	174.24	273.99	148.11	164	72
Oct., 1946	360.94	173.50	273.01	147.58	233	102
Sept., 1946	360.19	173.14	272.37	147.23	223	98
1946 (Av.)	345.94	166.29	262.25	141.76	248	109
1945 (Av.)	307.75	147.93	239.14	129.27	123	54
1944 (Av.)	298.72	143.59	234.73	126.89	96	42
1943 (Av.)	289.95	139.38	228.75	123.66	176	77

CONSTRUCTION COST .... WAGE RATES .... MATERIAL PRICES

1913 = 100	October 1946	October 1947	% Change	Change September to October 1946 Sept.	1946 Oct.	1946 %	1947 Sept.	1947 Oct.	1947 %
E N R Constr. Cost Index†	360.94	424.41	+17.58	360.19	360.94	+0.21	417.81	424.41	+1.58
E N R Building Cost Index†	273.01	320.58	+17.42	272.37	273.01	+2.35	317.08	320.58	+1.10

† *Does not reflect increased costs due to overtime, lower labor efficiency, delivery delays, etc.*

ENR 20-CITIES' AVERAGE

Common Labor	$1.072	$1.244	+16.04	$1.071	$1.072	+0.09	$1.221	$1.244	+1.88
Skilled Labor (Av. 3 Trades)	1.853	2.120	+14.41	1.853	1.853	0.0	2.101	2.120	+0.90
Bricklayers	1.975	2.252	+14.03	1.975	1.975	0.0	2.240	2.252	+0.54
Structural Ironworkers	1.860	2.147	+15.43	1.860	1.860	0.0	2.124	2.147	+1.08
Carpenters	1.725	1.963	+13.80	1.724	1.725	+0.06	1.938	1.963	+1.29
Structural Steel, base	2.35	2.80	+19.15	2.35	2.35	0.0	2.80	2.80	0.0
Sand, per ton	1.501	1.819	+21.19	1.501	1.501	0.0	1.812	1.819	+0.39
Lumber, 2x4 Fir, per M ft.	69.780	91.847	+31.62	69.947	69.780	0.0	89.980	91.847	+2.07
Lumber, 2x4 Pine, per M ft.	63.418	83.040	+30.94	63.418	63.418	0.0	81.170	83.040	+2.30
Common brick, per M	22.225	23.713	+6.70	22.055	22.225	+0.77	23.612	23.713	+0.43
Ready-mixed concrete, c.y.	8.315	9.261	+11.38	8.283	8.315	+0.39	9.187	9.261	+0.81
Struct. clay tile, 3x12x12	98.232	117.58	+19.70	98.232	98.232	0.0	118.91	117.58	−0.11

MATERIAL SHIPMENTS .... BUILDING PERMITS

	September 1946	September 1947	% Change	August 1947	% Change August to September
Steel (% operating Capacity) A.I.S.I., weekly average	88.1	90.1	+2	93.6	−4

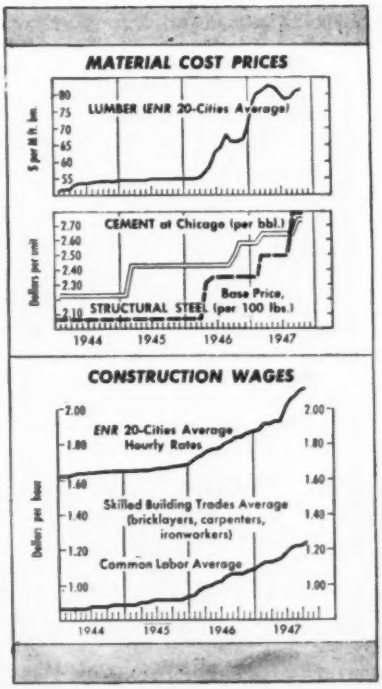
	July 1946	July 1947	% Change	Seven Months 1946	Seven Months 1947	% Change
Cement, thous. bbl. U.S.B. of Mines	16,249	20,099	+24	90,210	97,982	+9

	August 1946	August 1947	% Change	Eight Months 1946	Eight Months 1947	% Change
Fabricated Structural Steel, tons, A.I.S.C.	157,510	143,628	−9	945,599	1,179,032	+25
Building Permits, 215 Cities, Dun & Bradstreet (,000 Omitted)	$203,580	$290,044	+42	$1,902,563	$1,855,071	−2

COST OF LIVING INDEX .... EMPLOYMENT

Base 1935–39 = 100	1941	July 1946	July 1947	% Change 1946 to 1947	June 1947	% Change June to July
Consumers' Price Index, B L S	105.2	141.2	158.4	+12.2	157.1	+0.8
Rent (Housing) Index, B L S	106.2	108.5	110.0	+1.4	109.2	+0.7

	September 1946	September 1947	% Change	August 1947	% Change Aug. to Sept.
Constr. Employment (est.), thous., B L S	2,313	2,324	+0.5	2,239	+3.8
Private Constr. Employ. (est.), thous., B L S	1,843	1,864	+1.1	1,778	+4.8



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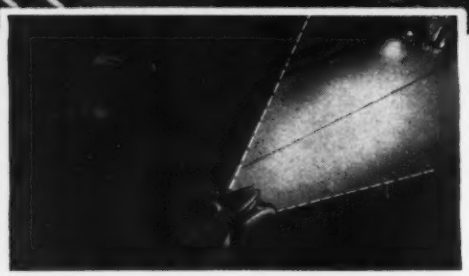
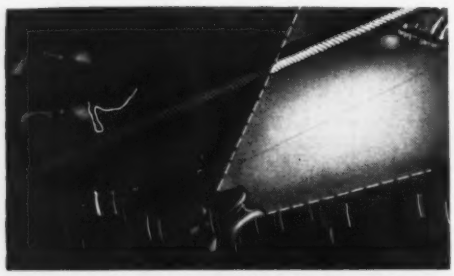


A smooth curb wastes the car's headlights. It reflects light away from the driver. Edge of road is difficult to see. Driving dangers are increased.



White Concrete Reflecting Curb utilizes the car's headlights. Saw-tooth faces mirror the light back to driver; form a continuous, bright ribbon of light at the road's edge. Driving is safer.

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News of the Week

ENGINEERING NEWS-RECORD • OCTOBER 16, 1947 • VOLUME 139 • NUMBER 16

Federal and state controls scored at APWA congress

American Public Works Association meeting reveals latent opposition to further encroachment on municipal functions—J. W. Morgan named new president

Municipal-works administrators can be counted upon for strong support in growing nationwide resistance to federal intervention in local affairs, it was apparent last week from spontaneous developments at the 53rd annual congress of the American Public Works Association, held in Jacksonville, Fla.

More than 400 members of the association met to discuss improvement of refuse disposal practices, financing and planning of public works, training of personnel, and the use of equipment.

Delegates, glancing at their programs at the opening of the conference, saw nothing on the schedule of the four-day sessions to indicate that local versus federal control would be an issue for discussion. Although it was an unscheduled subject, hardly a session went by that someone did not find occasion to express himself on the matter, and the climax came when Sam Baxter, the retiring president, tossed away his prepared remarks to deliver an extempore summation of what he considered to be the majority opinion of those present. This was, in brief: "The state and federal governments, particularly the latter, are calling the tune for municipalities far out of proportion to the number of nickels they are placing in the municipal juke box."

Tied to pollution control

Mr. Baxter recalled that at the very opening of the congress, in a paper on the technical aspects of stream pollution abatement, David B. Lee, chief engineer of the Florida State Board of Health, concluded with the statement that although his state had supported federal pollution control legislation, it would now go on record as believing in the greater effectiveness of action in which local control was paramount.

This touched off a lively discussion in which John F. Laboon, chief engineer of the Alleghany County Sanitary Authority, observed that those who opposed a federal pollution control bill usually advocated as a substitute that several states jointly combine to solve pollution problems on interstate streams. "What is federal control?" he continued. "It is nothing more than a combination of 48 states united under a single piece of legislation."

Mr. Laboon pointed out that unless there was a uniform, nationwide law for controlling pollution, industry might evade its responsibilities simply by moving to states where pollution control was less stringent.

Emphasizing the undesirability of federal control because administration generally falls into the hands of those unfamiliar with local situations, E. L. Filby, consulting engineer, Black and Veatch, Kansas City, related an instance where a Public Works Administration board of review, sitting in Washington several years ago, refused to okay plans for sewerage improvements in Memphis unless complete treatment was provided. When the board was informed that such treatment was unnecessary because of the great dilution afforded by the Mississippi River at this point, it developed that not one member of the board had ever been as far west as the Mississippi and had no familiarity with the size or character of the river at Memphis.

Cities "money-poor"

It was no comfort to the delegates, at a later session, to hear from H. Evert Kincaid, executive director of the Chicago Planning Commission, that the basic weakness of our cities in seeking to make physical improvements was the fact that they are money-poor because the states and federal government absorb most of the tax-producing wealth.

As a consequence more than one "Amen" was heard when Mr. Baxter concluded his talk by saying:

"Local governments cannot prosper if

(*Continued on page* 71)

Penna. road work blocked by rent law

The Commonwealth of Pennsylvania last week found itself barred from clearing the right-of-way for a proposed highway improvement by provisions of the Federal Rent Control Act of 1947.

A federal district court at Philadelphia handed down a decision enjoining the state from evicting tenants of four houses in the path of the proposed multi-million dollar widening of Vine St. in Philadelphia. The state had purchased the houses in order to tear them down, but then rented the structures during the war because machinery and labor were not then available for the widening project. Rental prices were registered with the now defunct Office of Price Administration.

Preparing to go ahead with its plans for the project, the state ordered eviction of the tenants in the buildings recently, and the matter was brought before the court (*ENR* Sept. 4, vol. p. 305). Richard Hay Woolsey, special counsel for the state, announced that the decision will be appealed to the U. S. Circuit Court of Appeals, and that if a decision is not rendered before Feb. 29, 1948—when rent control is slated to end—the residents will be evicted at that time.

The State Highway Department said that work will continue on all sections of the new roadway excepting in the locations where the four structures stand.

District Judge Guy K. Bard, in handing down the decision, said that a new highway would not qualify under the federal act as "new construction" to replace demolished housing. "The project is a commendable one," the jurist said, "but the legislative mandate expressed by Congress in the rent control act cannot be ignored."

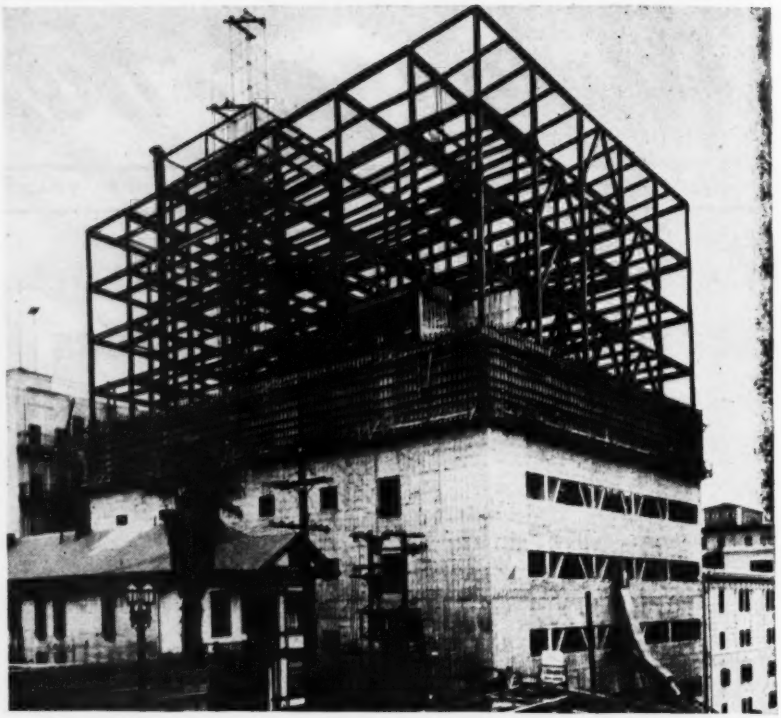
NEWS IN BRIEF

In telegraphic form, here are latest news developments on the engineering and construction front during the week.

Public Construction—*Pottstown, Pa.*, will start construction this year on airport improvements to cost $100,000 . . . An architect has been chosen for a $750,000 building at the State Hospital, *Norristown, Pa.* . . . Plans are under way for a $4,400,000 neurological unit at the General Hospital, *Philadelphia, Pa.* . . . In the same city work has started on the first phase of the Market St. subway extension . . . Welfare Secretary C. R. Barker of *Pennsylvania* estimates that the 172 general hospitals in the state need $250,000,000 for additions and improvements . . . A two-million dollar building program, principally for schools, has been approved at *Kenosha, Wis.* . . . Pennsylvania State College at *State College, Pa.*, has plans under way for three men's dormitories to cost $4,000,000.

Industrial Construction—Work has started on a new hydro-electric project at *Hagerman, Idaho*, by Idaho Power Co. . . . R. H. Macy & Co., Inc., New York is letting contracts for the foundation for a large suburban branch department store to be built on its site at *White Plains, N. Y.* . . . Canadian National Railway has plans for a $500,000 freight terminal in Edmonton, Alta. . . . Minnesota Linseed Oil Paint Co. will start a $5,000,000 expansion program with a $2,000,000 processing plant and elevator near *Minneapolis, Minn.* . . . Algonquin Chemical Co. has plans for a $1,000,000 sulphuric acid plant at *Dubuque, Iowa* . . . Construction is under way on the $15,000,000 addition to the Ohio Oil Co.'s oil refinery at *Robinson, Ill.* . . . Contracts have been awarded and excavation started for the $4,000,000 lubricating oil plant the Phillips Petroleum Co. has designed for a site adjoining its refinery in *Kansas City, Kan.* . . . N. Y. Central R. R. Co. expects to have its new union station at *Toledo, Ohio*, completed in three years . . . Builder C. V. McCright says the 21-story M & W tower at *Dallas, Tex.*, will be ready for occupancy in one year.

Highways—A $1,884,388 contract has been awarded to John F. Casey Co. by the state highway department for the new Elizabeth bridge across the Monongahela River in *Pittsburgh, Pa.* . . . A program to eliminate 17 dangerous railroad grade crossings and construct three bridges and viaducts in the *Columbus, Ohio*, area has been presented to the City Planning Commission, to involve an estimated city expenditure of $9,000,000 with additional expenditure by railroads, Franklin County, and the state . . . Governor Lane of *Maryland* has appointed a group of engineers, bankers, industrialists and business men to advise him and the State Roads Commission in the execution of the projected $169,000,000 state highway program . . . The first trailer park to be operated by the Delaware State Highway Department is to be constructed soon. The park is to be on the north side of *Indian River Inlet*, just west of the Rehoboth-Bethany Beach-Ocean City ocean highway.



***Dead Load Reduced**—Pacific Telephone & Telegraph Co.'s $2,000,000 10-story building in Los Angeles utilizes concrete made with lightweight pumice aggregate. Tests have shown cured concrete, which weighs about 90 lb. per cu. ft., to have a compressive strength of about 2,500 psi. Unusual window requirements of the building have necessitated a system of diagonal bracing in the center three bays of five in the north and south front wall. These members are 12-in. WF 53-lb. sections encased in concrete and are figured to take shear.*

Housing—Jack Stein has announced a $4,000,000 housing project for *Dayton, Ohio* . . . B. B. McCormick interests will start work soon on 25 apartment buildings at *Jacksonville Beach, Fla.*, to cost about $2,500,000 . . . Work has started on 21 apartment buildings to cost $1,000,000 in Wynnewood near *Dallas, Tex.*, by American Home Realty Co. . . . Bulldozers have moved in to clear sites for a $4,000,000 project at *Houston, Tex.*, to house 300 families . . . The Kynlyn Apartments Corp. has awarded a $4,500,000 contract for apartments at *Brandywine Hundred, Del.* . . . There are plans for 280 homes near *Rockford, Ill.* . . . New *Pennsylvania* developments include a $15,000,000 garden apartment at *Drexel Hill* and a $16,000,000 apartment development planned at *St. Davids.*

Sewers and Water Supply—Included in bonds approved by *Durham, N. C.*, for capital improvements is $1,750,000 for extending the waterworks system and $1,000,000 for enlarging the sanitary sewer system . . . *Moline, Ill.*, city council has adopted an ordinance for the issuance of $1,000,000 worth of waterworks revenue bonds. . . . A $217,770 contract has been awarded for an addition to the sewage disposal plant at the Pennsylvania State Hospital, *Philadelphia* . . . *Beverly, N. J.* has awarded contracts of $228,340 for alterations and additions to sewer plant and lines.

Federal controls scored by APWA

(*Continued from page 69*)

state and federal governments continually encroach on the functions of municipalities. With the heritage of freedom and self-determination which is ours in this country, we should be able to build and operate our streets, our sewage disposal plants, our airports and other facilities with a minimum of interference and control. This means that municipalities must assume full responsibility for the financing of work within their jurisdiction.

Pointing up the increasingly difficult problem of attracting young men to municipal work, Robert L. Anderson, superintendent of public works at Winnetka, Ill., reported that:

"With all of the unfavorable circumstances to which public service is now inherently subject (low salaries, political interference and slow advancement —Editor), it is only by special effort that we can induce young men of high ability and promise to undertake and continue careers in our field."

Mr. Anderson also cited limited school training facilities aimed at training men specifically for public-works administration, and urged that professional groups "accept the obligation" to promote the development of training programs.

More equipment available

Deliveries of street and road equipment are improving, according to H. F. Barrows, research director of the Austin-Western Co., Aurora, Ill., who ventured the opinion that there would be little increase in future prices.

He said that manufacturers serving municipalities are "not unaware" of the need to provide more equipment that is adapted to dual or multiple uses.

F. W. Jahn, representing the Gar Wood Industries, of Wayne, Mich., outlined the evolution of refuse-collection equipment and cited this as an example of special equipment that originated from the demands of municipal officials for structurally sound, sanitary, sightly and reliable machines.

Pointing to the desirability of mechanizing municiple operations, Lloyd M. Johnson, commissioner of streets and electricity, Chicago, reported that mechanical cleaning of streets in his city is costing only one-tenth of that by manual methods.

Displayed to the public for the first time was a new piece of equipment by Chadwick, Inc., Darby, Pa., called a "trailerized flusher". It consists of a 2,000 gal. trailer-tractor unit fitted with three flushing nozzles, designed to clean pavement surfaces under parked vehicles, and said to have sufficient capacity to flush 8 city blocks with one tank filling. In addition to this primary use, the unit was fitted with auxiliary fire fighting facilities and other devices.

In addition to the 21 exhibits on the convention floor, displays of heavy equipment were maintained on a side street where daily "clinics" were conducted in their use and operation.

Procedures that have been extensively and successfully used in other parts of the world to insure street cleanliness, but which have found relatively little application in American cities, were recommended by the street-cleaning committee of the association. As presented by William A. Xanten, supervisor of the city refuse division, Washington, D. C., these were:

1. The adoption of ordinances by all cities prohibiting not only the depositing of litter, dirt, etc., on public space, but banning also the sweeping of litter, dirt, etc., (excepting perhaps leaves during the fall season) from yards, buildings and sidewalks onto streets.

2. As a corollary, all cities should classify grass and hedge clippings, trimmings from shrubs and vines, yard and sidewalk sweepings, etc., in reasonable quantities as legitimate refuse, removable only by the refuse collection forces.

In a roundtable discussion on traffic problems, conducted by D. Grant Mickle, traffic engineer of the Automotive Safety Foundation, the conclusion was reached that the only real relief for congestion is off-street parking.

It was generally agreed in a session on planning conducted by H. H. Morgan, assistant director, Indiana Economic Council, that too many of the planners are "up in the clouds", and public interest cannot be enlisted in grandiose abstractions.

James W. Morgan, commissioner of public improvements, Birmingham, Ala., was elected president.

Elected to vice-presidencies were: William A. Xanten, Walter N. Frickstad, city engineer, Oakland, Calif., and Edward J. Cleary, executive editor, *Engineering News-Record*.

Glenn C. Richards, general superintendent of the Detroit, Mich., department of public works, was named treasurer. W. O. Jones, city manager of Fort Worth, Tex., and Allen H. Rogers, superintendent of public works, Garden City, N. Y., became directors.

Boston, Mass., was chosen as the place for next year's meeting.

PUBLIC WORKS OFFICIALS CALLED WARMONGERS

A startling view of U. S. public works officials as warmongers is being presented to the Russian people, according to Talbert Abrams, of the Abrams Aerial Survey Corp., of Lansing, Mich.

Mr. Abrams told members of the American Public Works Association that Russians picture U. S. road and highway builders as creators of facilities to speed the movement of war materials. "Our concern with sanitation is looked upon as the means for making Americans stronger and healthier—thus more aggressive," he added.

"Furthermore, public buildings are said to be built primarily as citadels for defensive war."

***Watauga Dam Progress**—TVA workmen clear rock foundation in preparation for earth fill at the Watauga Dam on the Watauga River five miles east of Elizabeth, Tenn. The rock and rolled earth fill dam will be about 900 ft. long, 320 ft. maximum height and 1,275 ft. maximum width at the base. Total cost of the project, including installation of one 25,000-kw. turbine, is set at about $28,900,000 primarily for flood control.*

Forms for the sixth floor of the new Hermann Professional Building at Houston, Texas, were hung from the framework above the seventh floor and were also lowered to position for concreting the fifth floor, as shown in photo at right.

Concreting From the Top Down on Texas Building

A type of concrete form construction believed to be employed for the first time in the United States was used in placing one of the floors of the $2,000,000, 14-story Hermann Professional Building in Houston, Texas.

Called the "D.C. System" from the Spanish *descimbrar cimbrando*—strip off and re-erect—this construction involves the successive pouring of floors starting from the top of a multiple-story building instead of the conventional procedure of beginning with the first floor and working upward. Experience in Mexico indicates that marked savings in time and cost can be realized.

Manuel Gonzales, young civil engineer of Mexico City who originated the D. C. System, has granted an exclusive license to promote the system in this country via Southwest "D.C.". System, Inc. Gonzales reports that the system has been used in 10 buildings completed in Mexico since 1945 and is being used in two others now under construction there.

In this system, a set of form panels, an assembly of forms within a bay, is constructed. The assembly, in this instance, consisted of a wooden gridwork supporting steel pans. However, the system is also applicable to flat slab construction. The assembly is supported from above by ½-inch steel rods, the number of these rods averaging 20 per bay. After pouring the bay, all rods but the four at the corners of the bay are removed. Those remaining are lowered simultaneously by four chain hoists. The supporting rods are then restored. The point of suspension is not the floor just poured but the floor above that, to allow time for the concrete to attain strength.

The rods necessarily must pass through the concrete flooring. To permit the rods to be easily withdrawn as the forms are lowered, wood "cones" are set in the forms at the points where the rods pass through the concrete. The Openings left by the cones are subsequently filled.

Advantages claimed

Southwest "D.C." officials point out that all shoring and supports necessary in conventional construction are eliminated, thus resulting in a saving in material. There is no destruction and rebuilding of forms from floor to floor so that labor is reduced to the minimum required for lowering and re-erecting the forms. Basing their estimates on the record of "D.C." construction in Mexico they claim that:

1. A form panel within a bay may be lowered and leveled on the bay below in about a half hour.
2. An entire floor of panels (about 30 bays) may be lowered and leveled in two working days.
3. A floor can be concreted and stripped each week.
4. It is possible to use the same set of forms, without dismantling, for as many as 30 times.
5. After the first upper floor is placed, workmen, and fresh concrete, are protected and work may continue regardless of weather.
6. Form construction costs are reduced and building time is cut; saving in labor is said to average about 40 percent.

For the Hermann Building, which is part of the $100,000,000 Texas Medical Center project, concreting was started at the sixth, rather than the top floor, to permit masonry work to begin sooner on the first floor. The plan was to complete the lower floors and then raise the forms to the top, working down to the seventh.

Said to be due to differences in interpretation of the subcontract and to difficulties in scheduling the forming and concreting, the D.C. system was used for only one floor on the Hermann Building. Both the general contractor and subcontractor feel that the D.C. system has considerable merit but details could not be worked out for this one job.

Architects associated on the work are Kenneth Franzheim and Wyatt C. Hedrick. General contractor is Linbeck and Dederick Construction Co. for whom D. M. Harwood is superintendent. Consolidated Steel Corp. of Texas did the fabrication and erection of structural steel.

NLRB sues in construction field

Two of the first three injunctions sought by the National Labor Relations Board under authority of the Taft-Hartley law involve secondary boycotts in the construction industry. They offer the first tests of this phase of the new law.

NLRB asked the federal district court at Owensboro, Ky., to enjoin members of the United Mine Workers, (AFL) from persuading employees of the Jackson Construction Co., general contractors, not to erect facilities at a strip mine being opened in Ohio County, Ky., by the Sentry Coal Mining Co. A court hearing was set for Nov. 9.

The Kentucky situation dates back to last April, when the Sentry company engaged in shaft mining in Hopkins County, decided to open a strip mine in Ohio county and retained the Jackson firm to construct a tipple.

After the coal company refused to sign a closed shop contract with the miners union in advance of hiring, a gang of men allegedly recruited by the union upset the construction machinery and ordered the contractor's crew to cease work.

Both companies complained that, for several weeks, they could not repossess their property and that local police could not cope with the situation. Workers were beaten.

Another court hearing was scheduled this week on an injunction requested Sept. 22 against the AFL carpenters union in Chattanooga, Tenn. Union members refused to work on a one-family house if linoleum was laid by the non-union employees of Watson Specialty Store—which sells and installs linoleum.

Although the linoleum was laid while the carpenters were absent, and the carpenters later returned to work, NLRB was hoping to get an injunction to bar such a secondary boycott by these same carpenters in similar situations in the future.

The Chattanooga case was the first in which NLRB has exercised jurisdiction over the construction industry, thus raising a possible test of whether home building affects interstate commerce and comes under the law.

Labor laws attacked in state courts

Two state labor laws, both imposing strict controls over union activities, were before state courts last week, as organized labor continued its legal attack on such measures.

In Nebraska, the state supreme court was asked to set a date in November for hearing a test case on an anti-closed shop constitutional amendment, previously upheld in the district courts.

In an earlier decision, District Judge Ralph Wilson of Lancaster County, Neb., said that the amendment adopted last November is a "valid and proper exercise of the state's police powers, and held that it did not infringe upon or violate any provisions of the federal constitution or the national labor relations act in prohibiting the closed shop and other restrictive union practices.

The action, brought by the American Federation of Labor, the Nebraska Federation of Labor and the Omaha Iron and Metal Workers Union (*ENR* June 26, vol. p. ?), was immediately appealed to the higher court.

In Utah, a new labor relations act which prohibits strikes or picketing, boycotting and similar practices without a majority approval of the union membership by secret ballot, was also in the state supreme court awaiting action on union appeals. In the first cases brought under the legislation, passed in 1947, the International Union of Operating Engineers (AFL) was found guilty by the Utah Labor Relations Board of calling strikes without authority of its membership. The actions were brought by the Palfreyman Construction Co. of Provo and the Wheelwright Construction Co. of Ogden.

Union officials claim that the "work stoppages" were "voluntary" and not ordered by union officials, and company lawyers pointed out that the operating engineers union's constitution is now in violation of the state's new labor statute in that it gives union officials permission to call strikes in certain instances without a vote of the membership.

Similar labor statutes passed within the last year are also under attack in Arizona and in Florida.

Pennsylvania Turnpike has record receipts

Receipts of the Pennsylvania Turnpike hit an all-time peak in August with operating returns of $601,431 as compared with an income of $471,881 in August of 1946, according to a recent report of the state's turnpike commission.

Concrete Institute holds first regional meeting

Birmingham, Ala., was the scene last week of the first regional meeting of the American Concrete Institute. Heretofore, only annual conventions have been held, but the presence of most of the national directors at Birmingham, and the success of this initial interim meeting, suggest that other regional meetings may be expected.

The program at Birmingham was arranged by Hugh P. Bigler and a local committee. An outstanding feature was a report by F. H. Jackson, U. S. Public Roads Administration, on his recent inspection of the German autobahns. I. E. Morris, of I. E. Morris and Associates, presented design and cost studies of five types of floor framing systems in which the slab-band system showed up best.

Research work on the bond of reinforcing bars, being carried on at the National Bureau of Standards, which may influence presently accepted design procedures, was outlined by Arthur P. Clark, research associate of the American Iron and Steel Institute, who has the work in charge. Stanton Walker, speaking on concrete aggregates, and Roy W. Crum, on highway research, were others who contributed to the technical program. Southern industrial development and prospects were outlined by J. B. Converse and C. R. Freberg, the latter representing the newly organized Southern Research Institute. A tour through the Conners Steel Co. plant gave the members and guests a first-hand view of some of this industrial activity.

Survey Conn. shore to combat erosion

The Connecticut Flood Control & Water Policy Commission has completed negotiations with the U. S. Beach Erosion Board for a survey of Connecticut's shoreline. This will mark the first step in an effort to establish corrective measures to halt and prevent beach erosion and restore beaches. The 1947 Connecticut Assembly appropriated $75,000 for the work.

Richard Martin, deputy director of the State Water Commission, declared that this marks the first case of a statewide erosion survey. Work will start during October and will be done by the Army Corps of Engineers, first in Fairfield, then Westport and Sherwood Island. The survey will then move to Madison, Milford and Hammonasset Beach, in order. Brig. Gen. Raymond G. Moses, division engineer, will supervise the work.

HIGHLIGHTS OF MUNICIPAL DEVELOPMENTS

Comprehensive city plans prepared for Atlanta, Dayton, other cities—Toledo nears end of pollution-abatement campaign—More state funds sought for Indiana communities

The need for coordinated community planning to take account of all factors affecting the growth and operation of cities was accented last week as officials in many areas considered new planning programs.

At Atlanta, Ga., a report issued by the Georgia School of Technology's engineering experiment station asserted that Atlanta is being "slowly strangled" economically by a lack of housing "more serious than exists in any other metropolitan center."

G. A. Rosselot, director of the experiment station, said that some 25,000 new workers have been prevented from settling in the city in the last few years by their inability to obtain adequate housing. A continuation of this trend toward a static or decreasing labor force could strangle the city, he added. He suggested that the solution lies in consolidation of groups of small contractors and in the simplification of sales methods by material dealers.

Montgomery County, Ohio, commissioners, meeting at Dayton, considered a formal 25-year master plan for development of the county's highway system that would facilitate development of subdivisions and tie in with existing roads and facilitate travel around and through the metropolitan center by a system of radial main arteries crossing the city, a circumferential highway around the city's outskirts (already partially under construction) and interconnecting routes.

At Washington, D. C., the National Capital Park and Planning Commission said it had engaged the firm of Harland Bartholomew and Associates to prepare a new comprehensive master plan for Washington, D. C. The firm will make its studies as a preliminary to preparation of a detailed plan to rid the city of blighted areas in the congested downtown sections.

Other planning developments included:

Approval of petitions at Kansas City, Mo., for an election on a $6,000,000 bond issue to finance improvements in the city and surrounding Jackson County; approval of designating five downtown Milwaukee, Wis., streets as one-way thoroughfares and regulation of cross-street traffic lights to keep through traffic moving; announcement that Omaha, Neb., will eliminate all turns on certain key streets in the downtown area; a program calling for an increase in the staff of the city engineer's office at Tampa, Fla., to cope with increased city programs.

And at Wilmington, Del., the city council approved a revision of the zoning ordinance to permit skyscrapers rising to a height of 35 stories in the northern section of the city, in response to urgings of Mayor J. S. Wilson and his zoning commission that such a change would spur business construction in the city.

Anti-pollution campaign

A stream-pollution elimination campaign that started five years ago was nearing a successful conclusion at Toledo, Ohio, last week, according to Councilman A. M. Jurrus, chairman of the city's committee.

Describing the five-year program, which is due to be completed this fall, Mr. Jurrus said that factory and sanitary waste has been eliminated from Ottawa River, Ten-mile Creek, Swan Creek and the west side of the Maumee River. Fish and other marine life, which had vanished from the streams when the program began, are now reappearing, and odors from the streams have almost disappeared. Mr. Jurrus estimated that more than $500,000 had been spent on the program to date.

City, county at odds

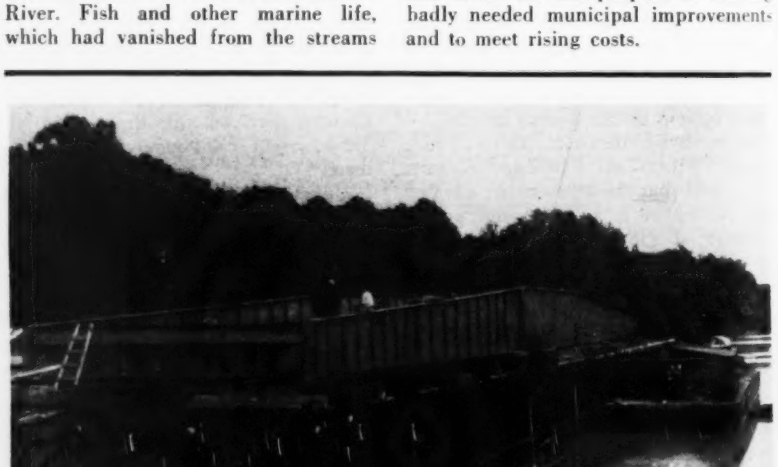
Because Los Angeles County officials failed to obtain a city building permit or to submit plans before starting construction, the Los Angeles City Building and Safety Department recently stopped work on a new temporary courthouse that the county is building on city-owned property.

The structure is being erected for courts which previously had been housed in the City Hall, but which have been evicted so that city administrative offices can occupy the space. Foundations and floor joists were laid on the site between the County Hall of Records and the Court House before the city issued the stop work order.

City Building Superintendent Gilbert Morris said that he would recommend that a building permit be granted, but for a 2-year period since city code requirements call for permanent construction of brick or masonry.

Seek more state funds

The Indiana Municipal League recently began a campaign to obtain a larger share of state funds for cities and towns for the purpose of making badly needed municipal improvements and to meet rising costs.



***Draw Section in Place**—The center section of a pivot-type bridge over the Roanoke River on U. S. Highway 17 near Williamston, N. C., rests on creosoted piling that eventually will form a permanent fender for the pivot pier of the structure. One of the largest bridge jobs ever let to contract in North Carolina, the new bridge will be 2,775 ft. long, including the center span. Approaches will be of concrete. Bowers Construction Co. of Raleigh holds construction contract.*

John C. Page to retire from federal service

John C. Page, 59, of Denver, Colo., a civil engineer who was Commissioner of Reclamation from 1937 to 1943, is to retire from federal service on Oct. 31.

J. C. Page

He was commissioner in the period during which were completed Grand Coulee Dam and a number of other important projects, including Imperial and Parker dams on the Colorado River, the Bartlett Dam in Arizona, the Seminoe and Alcova dams in Wyoming, Alamogordo and Caballa dams in New Mexico and Marshall Ford Dam in Texas.

Mr. Page resigned as commissioner because of ill health, but later resumed active duty as consulting engineer to the bureau.

He attended the University of Nebraska and Cornell University and entered the Reclamation Service in 1909 as a topographer in the survey of canals in Colorado.

Report cites potential Missouri Basin progress

Listing the vast potential development of the ten-state Missouri River Basin through stabilization of its agricultural economy and introduction of new industry, the Midwest Research Institute of Kansas City last week had released a comprehensive report on effects of the Pick-Sloan plan for development of the basin.

The study was undertaken at the request of Brig. Gen. Lewis A. Pick, chief of the Missouri River Division for the Corps of Engineers, and co-author of the plan. Some elements of the vast construction program are already under way, and others—notably Garrison Dam—are either under contract or ready for calling of bids.

Conducted under the direction of Harold Vagtborg, president of the institute, the report comments on the basically agricultural nature of the economy of the basin, and the need for stabilizing that economy through regulation of water resources, additional irrigation, and control of disastrous floods. Additionally, it lists mineral and other resources of the area, which include a large share of the nation's coal, oil and natural gas reserves, and suggests that new industries could be established.

Van Wagoner to head Bavarian military regime

Murray D. Van Wagoner, former Governor of Michigan, has been appointed director of the Office of Military Government for Bavaria by Gen. Lucius D. Clay, effective next month. He succeeds Brig. Gen. Walter J. Muller, who is returning to the United States for re-assignment.

Mr. Van Wagoner, who received a civil engineering degree from the University of Michigan, became Michigan state highway commissioner in 1933; served as president of the American Road Builders Association in 1939, and in 1940 was elected governor of Michigan. He had been an engineering consultant to General Clay in recent months.

W. T. Ballard resigns as Md. roads engineer

Wilson T. Ballard, chief engineer for the Maryland State Roads Commission for the last eight years, has resigned to return to the private practice of engineering.

He was at one time chief engineer of the Public Works Administration in Maryland and Delaware, and was a former vice-president of J. E. Greiner and Co.

William F. Childs, Jr., director of the traffic division of the State Roads Commission, has been appointed as acting chief engineer.

SCHOOL ROOF COLLAPSE PROVES ERRORS

The sins of the builders and designers almost caught up with the third generation in Salt Lake City, Utah, recently when a portion of a school roof collapsed. Fortunately, alert teachers noticed cracks in the ceiling plaster and were able to empty the building before a section of the roof of the 22-year-old West Jordan School collapsed.

A 3-man committee of building experts submitted a report that severely criticized designers and builders of the structure.

The report said, in part: "Workmanship was poor. Embedment of oversized gravel and pieces of wood, brick and old mortar in the concrete at critical points of rupture indicate a carelessness that could have caused failure of the ceiling girders, even if other weaknesses had not been present.

"Brick bearings of the girders were not designed or built strong enough to carry the load; reinforced concrete girders were underdesigned and smaller than called for in the plans, and gravel used in the concrete included sizes much too large."

Col. J. S. Gorlinski heads Sacramento District

Col. Joseph S. Gorlinski, who at one time was in charge of construction of Bonneville Dam, on Sept. 16 became chief of the Sacramento District for the U. S. Corps of Engineers.

Col. Gorlinski

Colonel Gorlinski replaces Col. Lester F. Rhodes as head of the district, which includes northern and central California, all of Nevada and western Utah. Rhodes was transferred two months ago to a new assignment at Potsdam, N. Y.

Colonel Gorlinski's latest tour of duty was in China. In 1944 he was assigned to Gen. Albert C. Wedemeyer's staff as chief engineer, and stayed on after the war with an Army advisory group. He was resident engineer in charge of construction at Bonneville Dam from 1934 to 1936. From 1940 until 1944 he headed the war plans division in the office of the Chief of Engineers in Washington, D. C.

Army starts building $29 million Woodruff Dam

The Corps of Engineers last week had launched its multimillion dollar program for the development of the Chattahoochee - Flint - Apalachicola river basin by breaking ground for the $29,000,000 Jim Woodruff dam.

Eventually the development will provide a 9-ft. navigation channel to Atlanta, Ga. on the Chattahoochee and to Bainbridge, Ga., on the Flint. In addition power and flood control are features of the project.

The concrete and earth embankment dam will extend across the Apalachicola River near Chattahoochee, Fla. for 6,100 ft. and will be 70 ft. high. It will contain a lock 82x450-ft. and provide a maximum lift of 33 ft. The power house will contain three 10,000 kw. units.

The dam will provide a 9-ft. channel on the Flint to 18 miles above Bainbridge and to the proposed site of the Upper Columbia Dam, opposite Columbia, Ala., on the Chattahoochee. When the Columbia Dam is completed the 9-ft. channel will extend navigation to Columbus, Ga. Other proposed dams will provide navigation to Atlanta. A dam to be constructed 50 miles above Atlanta at Buford will provide river level control during low-water season.

Safety council meeting discusses prevention

Vivid, dramatic portrayals of job planning to prevent accidents held the close attention of 250 in attendance at the two-day meeting of the Construction Section, National Safety Council, during the parent organization's 35th annual congress in Chicago, Oct. 6-10.

Repeating a technique that proved highly successful a year before, the program committee put on dramatic skits to illustrate the analysis and planning of actual construction jobs. Diagrams of job layouts and methods, projected on a screen, heightened interest in the acts.

Two panels of actors took part in the skits on successive days. The first program analyzed job layouts to eliminate interferences which would invite accidents. In the second, a contractor and his job staff dug into safety costs and savings gained through accident reduction on a construction project. Similar dramatizations of actual job studies are planned by the Construction Section for future presentation, both at annual meetings and before other construction groups.

Four speakers on the two-day program lent emphasis to the necessity for job analysis and pre-planning to avert accidents. After Art Matthias, safety coordinator for the Wisconsin vocational school system, had pointed to job analysis as a prerequisite for safety education, Brig. Gen. Lewis A. Pick, Corps of Engineers, gave a talk on "Controlling the Missouri River—A Real Safety Job."

Ohio road department may lose 3-cent gas tax

Atty. Gen. Hugh S. Jenkins plans to ask the Ohio Supreme Court to determine whether a law passed by the last session of the legislature took from the state highway department and townships $9,600,000 annually in construction funds and gave it to counties and municipalities for maintenance. If the court upholds this view, a special session of the legislature would be required to correct the situation.

Ohio Highway Director Murray D. Shaffer said the state would lose $5,400,000 in construction funds and the townships $4,200,000 annually, if the law is sustained. This is their share of the gasoline tax revenue. The municipalities would receive $5,234,500 a year more than previously, and counties, $4,365,500.

Revenue from the 3-cent gasoline tax is divided equally for maintenance and construction of highways and streets. In attempting to amend the section governing the distribution for maintenance, the legislature, either through accident or design, inserted a provision allocating the entire 3-cent tax for maintenance, leaving nothing for new construction.

Eastern building officials complete organization

Walker S. Lee, superintendent of buildings of Rochester, N. Y., has announced that organization plans of the Eastern States Building Officials Federation have been completed following formal ratification of the organization as an affiliate of the Building Officials Conference of America, Inc. The federation will be comprised of state and municipal building officials in New Jersey, Pennsylvania and New York.

Mr. Lee was elected president of the organization; C. Raymond Swain, secretary and executive officer of the Board of Tenement House Supervision of New Jersey, vice-president, and George H. Slenker, building inspector of Allentown, Pa., secretary-treasurer.

Kentucky road contracts cover 2,000 miles of work

About 2,000 miles of road construction and repair have been contracted for so far this year by the Kentucky highway department, according to State Highway Commissioner J. Stephen Watkins. Contracts let to date total $16,854,371—more than has been spent on Kentucky roads in any preceding 1-year period.

With easing in the structural steel situation, the department is pushing bridge work construction, Mr. Watkins said. At present there are 123 highway projects of all types actually under way, although many have been slowed by heavy rains during the construction season. In order to protect contractors facing penalties for failure to complete projects in the allotted time, the department has granted a blanket maximum extension of 58 days.

As an aid to future highway planning, the commission has asked the Public Administration Service, Chicago, for a complete survey of Kentucky's highway system with a view to formulating a long-range program for all classes of state roads.

The survey will be based on a review of state laws, as they pertain to the highway system and a detailed study of county road revenue and expense.

Colorado River group acts on water questions

Interpretations of certain provisions of the Colorado Compact that are the subject of dispute between the states of California and Arizona were approved on Oct. 2 by the Colorado River Basin States Committee.

Meeting at Salt Lake City, Utah, the committee consisted of representatives of Arizona, Colorado, New Mexico, Wyoming and Utah. It was organized in July of last year, after California and Nevada withdrew from the Colorado River Basin Committee of Fourteen and the Committee of Sixteen—two groups that were created in 1946 when California sought revision of the Boulder Canyon Act (*ENR* Sept. 12, 1946, vol. p. 335).

The committee meeting in Salt Lake City agreed to interpret the term "beneficial consumptive use" to mean the amount of water by which the main stream of the river is depleted, and took the position that the 1,000,000 acre-ft. increase in beneficial consumptive use, apportioned to the states of the lower basin by Article IIIb of the Colorado River Compact, should be considered as already apportioned and not subject to appropriation by California.

Evaporation, the committee concluded, should be charged against each state in the same ratio as it benefits from the project on which the evaporation loss occurs.

Each of these interpretations of the compact is favorable to the position taken by Arizona in its controversy with California over the waters of the lower river.

Test borings completed for Delaware River span

Test borings for foundations for the new Delaware River Memorial Bridge near Wilmington have been completed, Lieut.-Gen. Eugene Reybold (Ret.), engineer for the bridge division of the Delaware State Highway Department, said last week. Tests were directed by Carl H. Peterson, engineer for Howard, Needles, Tammen and Bergendoff, consulting engineers, of New York and Kansas City.

The engineers will shortly be ready to draw up specifications and ask bids for the two main river tower piers and the two main anchorages, to be located in the river between Atlas Point and a point near Salem Canal, N. J.

Boring operations had started last June 23. General Reybold revealed 44 borings were made, ranging in depth from 75 ft. to 271 ft.

OBITUARY

Lieut. Col. Joseph C. Letts, 74, retired reserve officer in the Corps of Engineers, died Oct. 4 in Chevy Chase, Maryland. Colonel Letts served in the Spanish-American War and as an engineer in World War I and until 1939, was principal engineer in charge of the construction section of the Office of the Chief of Engineers.

John Marvin Wright, 61, died Oct. 4 in Washington, D. C. As an engineering officer in the Army, he was responsible for the design and construction of Fort Drum in Manila harbor. During World War I, he served as assistant to the Chief of Engineers and to the Director General of Military Railways.

Theodore Maitland Mussaeus, 62, died Oct. 3 in Front Royal, Va. He spent a number of years as a civil engineer in Mexico and in Virginia.

W. Leonard Smith, 53, territory highway and aviation engineer for Alaska, died Sept. 30 at Seattle, Wash. Born in Seattle, he moved to Nome after serving in the Navy during the First World War and for many years was engineer in charge of operations for the Hammond Consolidated Mining Co. Mr. Smith was elected to the highway engineering position two years ago and also served as chairman of the Territorial Board of Road Commissioners.

George Albert Chadwick, 66, engineer, died Oct. 1 in Frederick, Md. Mr. Chadwick, civilian recipient of the Distinguished Service Award for work on the atomic bomb, was associated during the war with the York Safe & Lock Co., Clayton & Lambert Mfg. Co. and Vickers, Inc. At the time of his death, he was vice-president in charge of engineering at Vickers. A graduate of George Washington University in Washington, D. C., he served on the faculty of the university's school of engineering prior to 1940.

Arthur Thompson Cook, 66, of Lawrence, Kan., died Sept. 29. He was a civil engineer who had been employed in Chile for the last two years and he was en route home at the time of death.

N. H. Lee, 61, engineer and executive secretary for the Texas State Parks Board, died at Austin Oct. 2. He was an engineer for the National Parks Service for ten years, helping plan city and state parks in many Texas areas. He was chief engineer for the Texas Parks board before becoming its chief administrative officer two years ago.

Robert G. Lynn, 59, engineer who headed the former U. S. Engineers suboffice at West Palm Beach, Fla., died there Oct. 3. He went to West Palm Beach in 1930 after serving as lock and dam inspector at Vicksburg, Miss., and with the engineers at New Orleans, La. Latterly he had been superintendent of public works for Delray Beach.

Harvey B. Fleming, 74, former chief engineer for the Chicago Surface Lines, and at one time president of the Chicago City Railway Company, died Oct. 2, at Libertyville, Ill. Born in Newburgh, N. Y., his first job was with Hudson River shipbuilders. Later he became assistant engineer with various street car companies in Chicago and St. Louis. Becoming chief engineer of the Chicago City Railway in 1905 he remained in that position until his retirement in 1945.

Frank I. Consaul, 79, former city engineer of Toledo, Ohio, and long a civic leader of that community, died there Oct. 3. A graduate of the University of Michigan, he first became identified with the city government of Toledo in 1890 as an assistant engineer. He was head of the engineering department during the administration of Mayor Samuel M. (Golden Rule) Jones.

MAJOR MEETINGS

National Metal Congress and Exposition, Palmer House, Chicago, Ill., Oct. 18-19.

American Welding Society, annual meeting, Sherman Hotel, Chicago, Ill., Oct. 20-24.

Engineers' Council for Professional Development, 15th annual meeting, Mount Royal Hotel, Montreal, Canada, Oct. 24-25.

National Council of State Board of Engineering Examiners, 26th annual meeting, Hotel Pennsylvania, New York, N. Y., Oct. 27-29.

American Institute of Steel Construction, 25th annual convention, Roney Plaza Hotel, Miami Beach, Fla., Nov. 10-13.

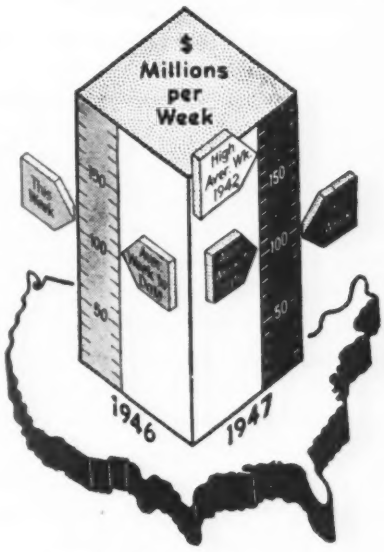
National Association of Housing Officials, 14th annual meeting, Hotel New Yorker, New York, N. Y., Nov. 17-20.

Highway Research Board, 27th annual meeting, National Academy of Sciences and National Research Council, Washington, D. C., Dec. 2-5.

National Society of Professional Engineers, Statler Hotel, Buffalo, N. Y., Dec. 4-6.

Society for Experimental Stress Analysis, annual meeting, Hotel Pennsylvania, New York, N. Y., Dec. 4-6.

CONSTRUCTION ACTIVITY



As Reported this week to ...
Engineering News-Record

CONTRACT VOLUME

Continental U. S. Only
(Thousands of Dollars)

	Week of Oct. 16 1947	Cumulative 1947 (42 wks)	Cumulative 1946 (42 wks)
Federal	$4,261	$513,589	$529,057
State & Mun.	29,869	1,391,365	1,182,034
Total Public.	$34,130	$1,904,954	$1,711,091
Total Private	57,208	2,552,581	2,671,675
U. S. Total..	**$91,338**	**$4,457,535**	**$4,382,766**

WHERE CONSTRUCTION ACTIVITY ORIGINATED THIS WEEK

Dollar Volume (Thousands)

Type of Work	This Week	Cumulative 1947 (42 wks)	Cumulative 1946 (42 wks)
Waterworks	$1,559	$88,746	$93,085
Sewerage	2,805	111,132	92,541
Bridges	3,216	150,038	108,918
Highways	9,345	644,022	645,663
Earthwork, Waterways	2,106	242,879	291,672
Buildings, Public	10,999	463,402	337,551
Industrial ...	23,361	722,449	891,495
Commercial ..	32,365	1,486,746	1,606,862
Unclassified ...	5,582	548,121	314,979

NOTE: Minimum size projects included are: Waterworks and waterway projects, $22,500; other public works, $40,000; industrial buildings, $55,000; other buildings, $205,000.

NEW PRODUCTIVE CAPITAL

	Cumulative 1947 (42 wks)	Cumulative 1946 (42 wks)
NON-FEDERAL ...	$1,434,853	$1,256,721
Corporate Securities	720,304	357,347
State and Municipal	966,838	674,374
Fed. Aid Highway.	247,711	225,000
FEDERAL	818,729	1,714,695
**Total Capital ..... **	**$2,753,582**	**$2,971,416**

ENR INDEX NUMBERS

Index Base = 100		1913	1926
Construction Cost..	Oct. '47	424.41	204.01
Building Cost	Oct. '47	320.58	173.30
Volume	Sept. '47	255	112

EDITORIALS

VOLUME 139 NUMBER 16

October 16, 1947

Fateful River

WHAT HAPPENS in the Rhine River valley of Germany in the next few months and years will be of momentous importance to every American citizen. If it is good, prospects will be favorable for the peace to be kept in our time. If it is bad, or too little, Europe as we know it—and want it— will cease to exist. With such stakes in the balance—and the Marshall Plan affording the necessary counterweight—it is important for Americans to know and understand the Rhine. What are its hydraulic and transport characteristics? Why is it of such commanding importance in Europe's economy? What is its present condition? Are the plans and prospects for its improvement effective and courageous enough to meet the requirements of the industrial revival envisaged in the Marshall Plan? Are current bridge building efforts resulting in any innovations in design or construction? The first of two articles directed toward answering some of these questions appears in this issue. Despite recording substantial and continuing progress in restoring this great waterway to effectiveness, the answers will suggest that, unless greater efforts are made, the Rhine will not be ready in time to handle the load that current plans for industrial recovery assume that it will. What happens to the Rhine is fateful in this respect.

In Support of Local Autonomy

FURTHER ENCROACHMENT of federal control in both state and municipal activities, which was stimulated by political expediencies in the '30s and reached its climax under the necessities of war during the '40s, is destined to be challenged. Such must be the appraisal of current trends, the latest token of which found expression in the sessions of the American Public Works Association last week. As reported elsewhere in our news pages, this group of administrators in the field of local public works has had its fill of directives and other forms of control emanating from Washington. The lure of a handout in the form of loans or grants of money is properly understood now as representing nothing more than a mortgage on local autonomy. And the background of experience gained by those who have been so intimately associated with the conduct of municipal public works under such terms is such as to discourage further "mortgages". This attitude does not stem from the fact that municipalities have lots of money and can afford to be independent. Exactly the opposite is the case: town and city governments are having a hard time to make ends meet. What they do ask, however, is a more substantial return of taxes collected locally and the right of self-determination in the way this money should be spent. We commend the APWA delegates, and hope that the sentiments they expressed will find strong support in other important segments of our democracy.

Convention Programs Again

EVERYONE who attended last week's convention of the American Public Works Association had ample opportunity to ask questions and otherwise participate in the discussions. This is an objective that all technical societies should seek to emulate. The APWA convention sessions are arranged primarily to provide for concurrent group discussions under leaders who function simply to encourage the asking of questions and the sharing of opinions. As a result there is created great individual interest, with a pooling of experiences that serves the specific needs of many and enriches the knowledge of all. Today, when most societies have facilities for the publication of formal papers, it is a sacrifice of time to present them on convention platforms when more important things might be accomplished. Many organizations could render improved service to their members by using the convention procedure practiced by the APWA.

Contingent Items in Bids

A CONTRIBUTING FACTOR to the present high cost of construction is the contingent item in contractors' bids. How it can be reduced is of vital concern to engineer and contractor alike, but first responsibility rests with the engineer who can reduce many job uncertainties by wisely drawn specification and contract provisions. Supplying accurate subsoil information is perhaps the most widely recognized way to prevent a bidder from worrying himself into including an extra just in case. Another way to assure lower bids is to define the amount of work that will be required under the contract, reserving

as an extra any work that may be necessary over the minimum. This procedure is especially effective when the engineer has to specify results, as he sometimes must. Compacting of earth fills to a certain density is an example, and a case in point is recorded in the article in this issue on the Baltimore airport, where lower bids were secured as a direct result of such a well drawn agreement. On their part, contractors can often reduce contingencies by averaging high profit jobs in the past against current bids. Some of this averaging is possible today. In view of the danger of greatly reduced volume inherent in too high construction costs, it would be in the contractor's self-interest to gamble a little on lower contingencies, even though competition may not yet require it.

Looking Beyond a Pier Fire

NEW YORK has had another costly pier fire, one that left the steel superstructure a worse-than-useless wreck because fire spread unchecked from end to end of the timber substructure. This complete destruction was wholly unnecessary since experience has shown that the spread of fire under the decks of such piers can be retarded by the installation of firestops and access manholes for special fire-fighting equipment. However, as the pier is a complete loss, the owners are faced with the question of how to replace it, which in turn raises a question of special significance to engineers, namely, whether some different type of construction should be employed.

Traditionally, piers along the Hudson River at New York have been supported on long timber piles driven into the soft silt. Because of the great depth to firm material at the pier-head line, estimated at 200 ft. or over, no other type of construction could compete with this type. But conditions have changed in the past few years. The cost of timber piles has skyrocketed and much new knowledge has been gained in the use of steel or steel-and-concrete piles or cylindrical piers to support marine structures. For example, steel H-piles about 200 ft. long were used recently in building the new pier for Seatrain lines on the New Jersey side of the Hudson at New York; and out in San Francisco Bay, 3-ft. steel caissons were driven to similar depths during the war and tested under loads running up to 385 tons (*ENR* June 27, 1946, vol. p. 974). Not to be overlooked is the spectacular job of building supports for submarine oil-well derricks in Venezuela (*ENR* Dec. 26, 1946, vol. p. 859) where 5-ft. reinforced concrete cylinders 185 ft. long were used. Also, new techniques have greatly extended the depths to which proprietary piles can be used with confidence.

Major obstacles to the application of this new experience to marine pier construction will be antiquated building codes, conservatism or inertia on the part of owners, building officials and consulting engineers, and lack of knowledge as to what loads can safely be carried by piles or caissons sunk to firm materials, which probably means rock on either shore of the Hudson at New York.

Such a condition points to the need for some test installations to establish criteria to guide those who must make the final decisions. Obviously, where it is necessary to go to great depths, as at the outer end of long piers on both sides of the Hudson, ultra conservatism in fixing the safe loads for deep piles or caissons will add greatly to the cost of pier construction, hence the research should be thorough. In the long run, the New York City Department of Marine and Aviation would be amply repaid for such a study; or the study might be conducted by the Port of New York Authority, which has proposed to take over and rebuild four old piers at Hoboken, N. J.

When the results of such a study are available it will be possible to make estimates to compare the cost of piers built by these newer methods with piers supported on timber piles. Such comparisons may show that timber-pile construction, with effective firestops, still has a competitive advantage over steel or concrete piles. And if reinforced concrete is used for the caps of these timber piles and for the deck stringers and deck, the risk of a fire spreading below the deck would be negligible.

Finally, in any such study of pier construction in New York harbor consideration must be given to the possibility of marine borers attacking timber piles as the harbor waters are freed of pollution, and to the life expectancy of steel and concrete exposed to the harbor waters.

Wise planning for future pier construction or for reconstruction of existing marine structures can only be made on the basis of extensive research.

ENGINEERING NEWS-RECORD
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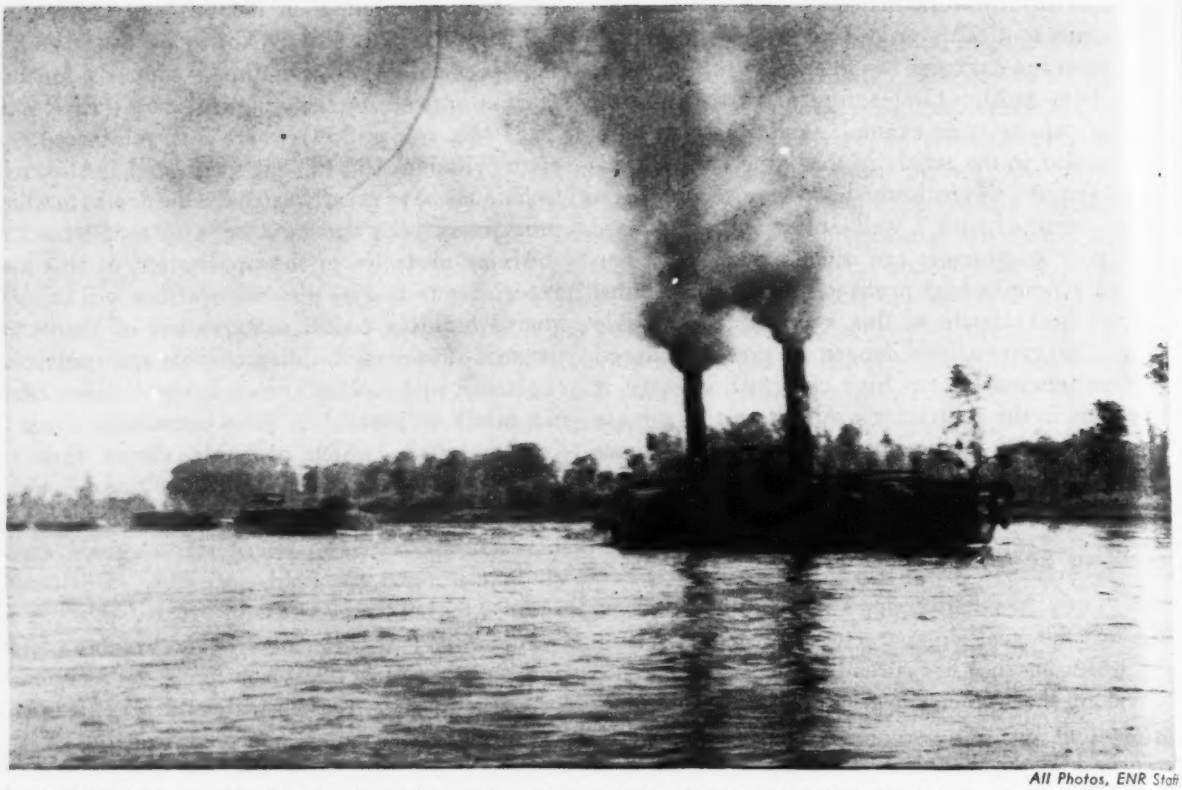

All Photos, ENR Staff

Fig. 1. Rhine tugs are sidewheelers that pull long lines of barges, in contrast to the sternwheel steamers of the Mississippi that push barge rafts ahead of them.

THE RHINE

1. How the World's Greatest Waterway Works

Col. George R. Clemens
Chief, Engineering and Operations Branch,
Construction Division, European Command

John H. Verhey
Chief Engineer,
Central Rhine Navigation Commission

MANY United States soldiers first saw the Rhine as they stormed across at Remagen or in the Ruhr, but gave little thought to its importance except as an obstacle to progress eastward. At right angles to lines of communication, it was not used by the Allied Forces during combat, and no serious effort was made to clear its destroyed bridges and wrecked boats until after the fighting ceased.

Today the Rhine has a new significance even more compelling than in wartime. For centuries it has been Europe's trade lifeline, up which commerce from the seaports of Rotterdam, Amsterdam and Antwerp has penetrated to the interior, and down which have moved industrial, mining and agricultural products of the vast hinterland. Within Germany itself, too, by means of the Rhine and its connecting waterways, much internal distribution has been accomplished. All these functions, dislocated by the war, must be restored, for the Rhine is truly an international river, which is of vital importance to the economic life of five separate nations—France, Belgium, Holland, Switzerland and Germany—as well as to all the countries of the world with which these nations have trade relations.

To understand the problems of the Rhine a brief description of the geography of the basin (Fig. 2) is necessary. Rising in the high mountains of Switzerland, the river flows through Lake Constance, and on a long leg westward, to near Basle, it is the border between Germany and Switzerland. Basle, the only Swiss port, has a modern, well developed harbor, and supported an annual traffic up to three million tons before the war. Near Basle the river becomes the boundary between Germany and France, and gradually flattens from the swift flowing mountain stream of Switzerland.

Between Basle and Strasbourg there are no major tributaries, so the flow is still relatively swift. The only lock on the Rhine, constructed by the Ger-

Fig. 2. The Rhine river system of main stem, tributaries and canals serves a large part of Western Europe and taps five different countries. Only a small part of the connecting canal networks is shown.

mans as part of their reparations to France following the first World War, is about nine miles below Basle at Kembs. The canals approaching and leaving the lock chamber are located entirely in France. The remainder of the reach to Strasbourg has open river navigation, with a channel regulated by dikes and bank protection works. This project has been under joint German and Swiss construction since 1925.

At Strasbourg the Rhine-Marne canal and the Rhine-Rhone canal both join the river. Through these canals light barge traffic may pass, by way of the Rhine-Marne to Paris, and the Atlantic at Le Havre, or through the Rhine-Rhone canal down the Rhone Valley to the Mediterranean at Marseilles. Canal traffic over these routes is slow, but offers a relatively inexpensive means of transportation.

Strasbourg is a large railroad center from which rail distribution to France is accomplished. A major port has been developed, with unloading and storage facilities of all types, large liquid fuel installations and a modern shipbuilding plant. Immediately across the Rhine is the German port of Kehl, which was one of the important terminals for coal barged up the river. Railroads cross the Rhine at Strasbourg-Kehl, and connect with both the German and French interior.

Below Strasbourg the open river regulated channel continues to be the boundary between Germany and France to a point near Karlsruhe. Under improvement for many years this reach is well developed and requires only a relatively small amount of channel maintenance.

Below Karlsruhe the river, now entirely in Germany, continues through the same type of channel to Mannheim where it is joined by the first large tributary, the Neckar. A series of cut-offs were made about 100 years ago in this reach in the section between Germersheim and Spire, which were not unlike those made in the Greenville Bends on the Mississippi River during the period 1932-1935. Mannheim on the right bank and Ludwigshaven on the left bank of the river were together a major port, and German industry of all types grew up in this area. Several large harbors

The Articles and the Authors

Long the most famous and most used of the world's inland waterways, Europe's Rhine River in 1947 occupies a place of importance unequalled in its two-thousand-year history. Built into a dominant position in Europe's economy by the works of engineers and construction men, the Rhine must be restored to something near its former efficiency by these same forces if that continent's recovery, and even world recovery, is to be achieved.

That being the situation, the problems of the Rhine are world wide problems, and its facilities, mode of functioning and present condition are of world wide interest. Two articles, therefore, have been planned to bring the Rhine more clearly within the orbit of American engineers. In the first, Rhine navigation history and problems are described by two of the outstanding authorities in the field. Mr. Verhey, a Dutch civil engineer, has had a lifetime association with Europe's waterways. Before the war he was chief engineer of the Zuider Zee reclamation project, and more recently was in charge of filling the gaps blown in the Walcheren Island dikes by the Germans.

Colonel Clemens is well known in America from twenty years with the Board of Engineers for Rivers and Harbors, and as engineer on the Mississippi River Commission. From the end of the war until early this year Colonel Clemens was in charge of Rhine clearance and navigation in the American Zone. The second article, by Waldo G. Bowman, editor, Engineering News-Record, will be concerned with the construction operations attendant to bridge building and channel clearance which he witnessed on a two months' stay in Europe this past summer.

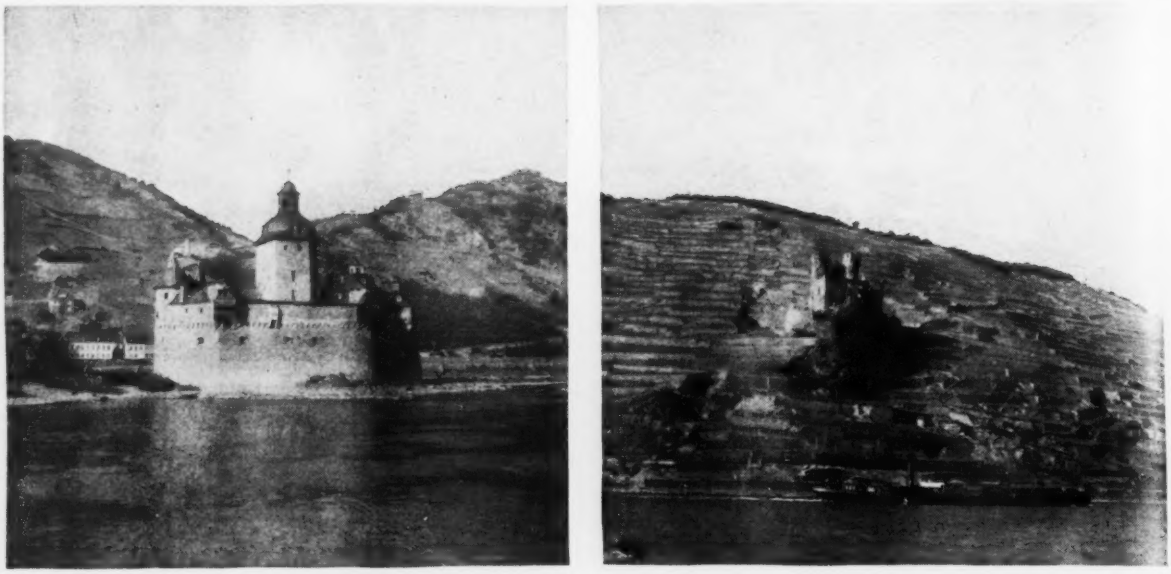

Fig. 3. In the Middle Ages Rhine traffic was controlled by noblemen from their castles at strategic high points or from towers at the river level. Left, The Pfalz, a toll collector's stronghold on an island. Right, Ehrenfels Castle, opposite Bingen.

were dredged on either side of the river with tremendous warehouses, open storage facilities, and modern unloading and cargo handling equipment. Mannheim-Ludwigshaven was also an important distributing point for the German interior.

The Neckar, rising in the Black Forest area, more or less parallels the Rhine until it reaches the vicinity of Heidelberg where it turns west to join the Rhine at Mannheim. A modern lock and dam project has been constructed on the Neckar with 7-ft. navigation to Heilbronn, where a modern port with storage, warehouse and unloading facilities has been constructed.

Below Mannheim the Rhine continues through level plains to the vicinity of Mainz where it is joined by the Main River from the east. This reach of the river has been stabilized for many years with channel regulating works similar to those in the Karlsruhe-Mannheim sector. Here, too, cut-offs were made about a century ago.

The Main River has been canalized from the Rhine to Wurzburg, with a double lock system extending as far as Frankfurt. Depths are 7½ ft., slightly more than on the Neckar. Major ports were developed at Frankfurt, Aschaffenburg and Wurzburg. At each of these points excellent rail connections are available for transportation within Germany, and from either Aschaffenburg or Wurzburg, commerce can move by rail to Czechoslovakia and the east.

Below Mainz the river passes through the so-called "gorge" section beginning at Bingen. In this reach the Rhine cuts through the Taunus Mountains in a narrow winding channel with steep slopes rising on either side covered with forests or the vineyards producing the famous Rhine wine. At one of the sharpest bends in the lower portion of the gorge waits the Lorelei, legendary siren, who, by her songs and beauty, lures unwary boatmen to be dashed to bits if they permit their gaze to wander from the treacherous bends of the channel.

Gorge section limits boat draft

Through the gorge section the current is swift and treacherous, and relatively high tow boat power is required to pass tows upstream. The paddle tug, a shallow draft, high-powered side-wheel type boat, was originally developed for this reach. Tows are normally divided in passing through the gorge. The channel is held in place by many dikes and, although lock and dam projects have been proposed for over 100 years, none has been constructed as the delay incident thereto has been considered more objectionable than the extra power required to move barges upstream through this reach.

The lower end of the gorge is near St. Goar. At Coblenz the river again comes into open country, and is joined from the east by the Lahn a small tributary made navigable by locks and dams only for very minor navigation. A short distance up this stream is the city of Limburg, famous for its cheese.

From the west at Coblenz the Rhine is joined by the Moselle, which likewise has only been improved for shallow draft navigation. The Moselle and its tributaries, the Saar and the Meurthe, reach entirely through western Germany into France and Luxembourg and, through the Meurthe, connect with the Rhine-Marne canal near Nancy, France. Coblenz, although having some harbor facilities, has never been developed as a major port.

Near Remagen the Rhine passes through a secondary mountainous section, but at Bonn it definitely enters the plains, and flattens out through the industrial area of Cologne, Dusseldorf and the Ruhr. Cologne and Dusseldorf are major industrial ports at which railroad systems cross and connect with the Rhine and from which traffic may flow to western and central Germany. Below Cologne the river deepens and supports shallow-draft coastwise traffic, in addition to barge movements.

The main Ruhr port is Duisburg-Ruhrort, where a canal connects the Rhine with the main canal and river system of northern Germany.

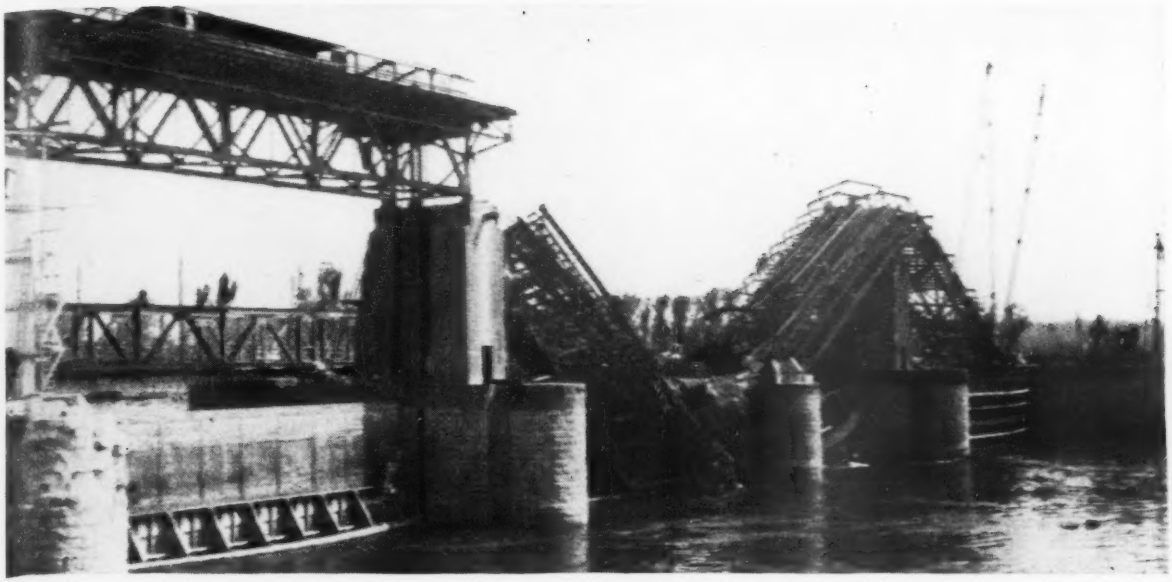

Fig. 4. Only dam on the Rhine, at Kembs, a few miles below Basle, was wrecked by the Germans, but is now repaired. Ship locks were not damaged. French have plans for several more similar dams to create slack-water navigation pools.

Ruhrort was the main coal loading port in the lower river, from which coal and steel either moved upstream for internal distribution, or downstream to the sea.

A short distance upstream from Nijmegen the Rhine crosses the Dutch border. In this section it resembles the Mississippi below Nachez, being generally wide and sluggish, with some sand and gravel bars. Depths are more than 9 ft. most of the year, which is approximately the same as for lower Mississippi navigation.

Within Holland, the Rhine divides into several branches. One branch, navigable for smaller craft only, empties into the Zuider Zee in North Holland, which has been diked off from the North Sea. A second branch, called the Lek River, also only navigable for smaller craft, passes through Arnheim to join the southern branch in the vicinity of Rotterdam. The main channel of the lower Rhine, which the Dutch call the Waal River, passes through Nijmegen to Dordrecht which is the dividing point for traffic to the ports of Rotterdam and Antwerp. Amsterdam traffic leaves the river a short distance upstream at Gorinchem via a canal. Below Dordrecht one branch continues through Rotterdam to join the sea at the Hook of Holland.

The lower reaches are tidal, and resemble estuaries. Traffic can flow with approximately the same ease to Amsterdam, Rotterdam or Antwerp, although the distance from Duisburg to Rotterdam is slightly less than to Amsterdam and considerably less than to Antwerp. At these ports the Rhine barges may discharge their cargo to ocean vessels for any ports in the world or receive cargo brought in from any portion of the globe.

Waterway characteristics

In Table 1 are given the controlling hydraulic characteristics of the Rhine. The length of the river is approximately 430 miles from Basle to the sea as compared to the 1,000 miles from Cairo to the Gulf of Mexico on the lower Mississippi. Most of the tributaries enter at and above Coblenz. The low water flow below Coblenz is approximately 30,000 cu. ft. per second, which compares to 100,000 cu. ft per second of the Mississippi at Vicksburg. Likewise the maximum recorded flood flow below Coblenz is 400,000 cu. ft. per second which is about 13 percent of the maximum 3,000,000 cu. ft. per second of the Mississippi River at Arkansas City below the mouth of the Arkansas.

Traffic on the Rhine in the Middle Ages was controlled by each castle or schloss from its strategic rocky height, the noble inhabitants levying

Table 1—CHARACTERISTICS OF THE RHINE RIVER

Reach	Length *Miles*	Average Channel Width (Low Water) *Ft.*	Controlling Low Water Channel Depth *Ft.*	Ordinary Low Water Flow *Cu. ft./sec.*	Maximum Flood Flow *Cu. ft./sec.*	Average Mid-Stage Velocity *ft./sec.*	Average Slope of Bottom *ft./mile*
BASLE to STRASBOURG	20	250	4	17,000	120,000	7 to 9	3.5 to 5
STRASBOURG to MANNHEIM	82	250	5	20,000	140,000	4 to 7	1.0 to 3.5
MANNHEIM to MAINZ	45	500	6	22,000	230,000	3 to 4	0.5 to 1.0
MAINZ to COBLENZ	56	500 (Gorge 300)	6	27,000	270,000	3 to 4 (Gorge 6)	0.5 to 1.0 (Gorge 3.5)
COBLENZ to COLOGNE	67	500	7	31,000	400,000	4	1.0
COLOGNE to DUTCH BORDER	105	500	8	36,000	440,000	3 to 4	0.5 to 1.0
DUTCH BORDER to ROTTERDAM (South branch only)	85	800	9	24,000	300,000	tidal to 3	tidal to 0.5
ROTTERDAM to NORTH SEA	20	1,000	40	tidal	tidal	tidal	tidal

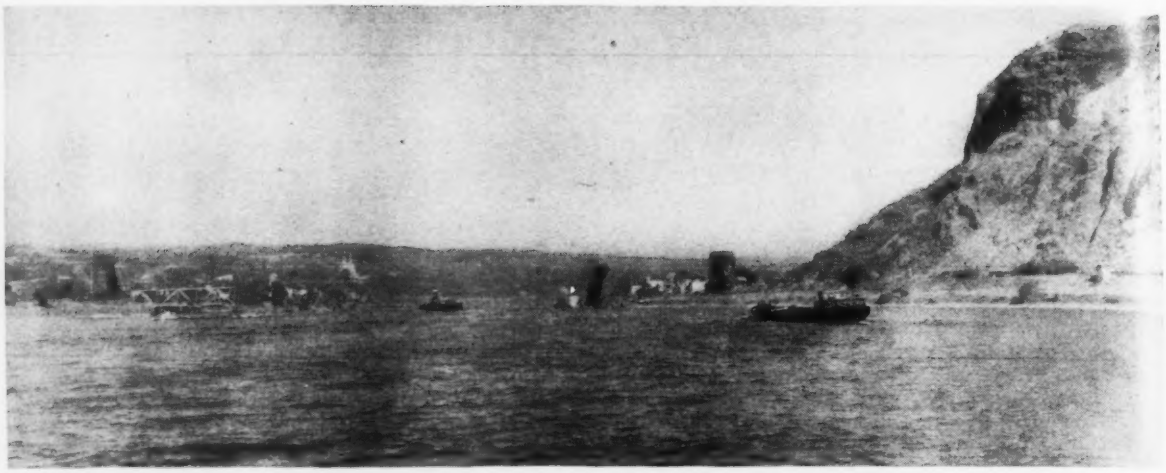

Fig. 5. The Rhine at Remagen. Traffic moves through a cleared opening in the middle of the river, while derricks work at either side to remove the remainder of this famous bridge over which American troops first crossed the Rhine.

toll on passing boatmen. However, as the countries of Europe began to take shape, about the beginning of the 19th century, the principle of free navigation on the Rhine was established. At the Congress of Vienna, in 1814, the first Central Rhine Commission was set up in accordance with the agreement that "The navigation of the Rhine shall be entirely free and shall not be forbidden in respect to commerce to anyone."

This principle of free navigation has prevailed to the present time except for interruptions during war periods. The Mannheim Conventions of 1868 further strengthened the Commission and established basic principles which were followed until the first World War.

The Control Rhine Commission was reconstituted by the Treaty of Versailles and again strengthened, resuming its life in June, 1920. It included all riparian states and Great Britain and Italy until November, 1936, when Germany withdrew as she stated she no longer considered the Versailles Treaty binding on German waterways. The Commission, however, continued to function without German membership until 1939 when the war began.

Following the conclusion of the second World War a new provisional Commission was formed in the fall of 1945. Membership consisted of delegates from the United States, France, Great Britain, Holland, Belgium and Switzerland. This Commission has functioned as a policy-making organization, and has exercised powerful influence on its member governments in Rhine River matters during this post-war period.

Traffic on the Rhine

Rhine River traffic reached a peak in 1937 when the total movement was nearly 100,000,000 tons, including both the through traffic, either from or to the sea, and the internal traffic within individual countries or between riparian nations. In addition to these three main types of traffic there has been much miscellaneous internal traffic from one small loading or unloading point to another. A stone quarry will have its loading dock where a cableway with bucket conveyors would load barges. Or a small community would have its own dock for handling miscellaneous package freight and food stuffs. Gravel dredging and fishing on the river itself have been quite extensive although in the lower river, dredging had been rigidly controlled to prevent the movement of too much material from the channel with a consequent lowering of the river bed and a disturbance of the navigable depths.

Imports from the sea to the interior include:

Iron ore, other metals, petroleum products, grains and miscellaneous cargo to the Ruhr or the Cologne-Dusseldorf industrial area.

Petroleum products, grain, and raw materials to the interior industrial centers of Germany, such as Frankfurt and Mannheim.

Grains, petroleum products and miscellaneous cargo to France passing through the Port of Strasbourg.

Grains and miscellaneous cargo to Switzerland, entering at Basle.

Domestic movement involves:

Coal from the Ruhr to the upper Rhine River ports for distribution into interior Germany, and brown coal shipments from the Cologne area.

Coal from the Ruhr to France through Strasbourg.

Coal from the Ruhr to Switzerland through Basle.

Coal from the Ruhr to Holland and Belgium.

Steel and other industrial products from the Cologne-Dusseldorf-Ruhr area to internal German ports, to Strasbourg, or to Basle.

Lumber and forest products from up-river ports to the Cologne-Ruhr area.

Manufactured products from one major port to another.

Exports to Amsterdam, Rotterdam, Antwerp and Ghent included Ruhr coal; Ruhr industrial products; miscellaneous products from internal German ports, such as Mannheim-Ludwigshafen, Frankfurt and Mainz; and potash and other products from the French port of Strasbourg.

Traffic movement on the Rhine for the year 1934 is charted in Fig. 6. The heavy flow in the reach below Duisburg-Ruhrort, with the major traffic through the Dutch port of Rotterdam and a smaller movement to Amsterdam, is particularly notable. The Belgian ports of Antwerp and Ghent received about one-fifth of the over 40 million-ton total. In general, total traffic is about equally di-

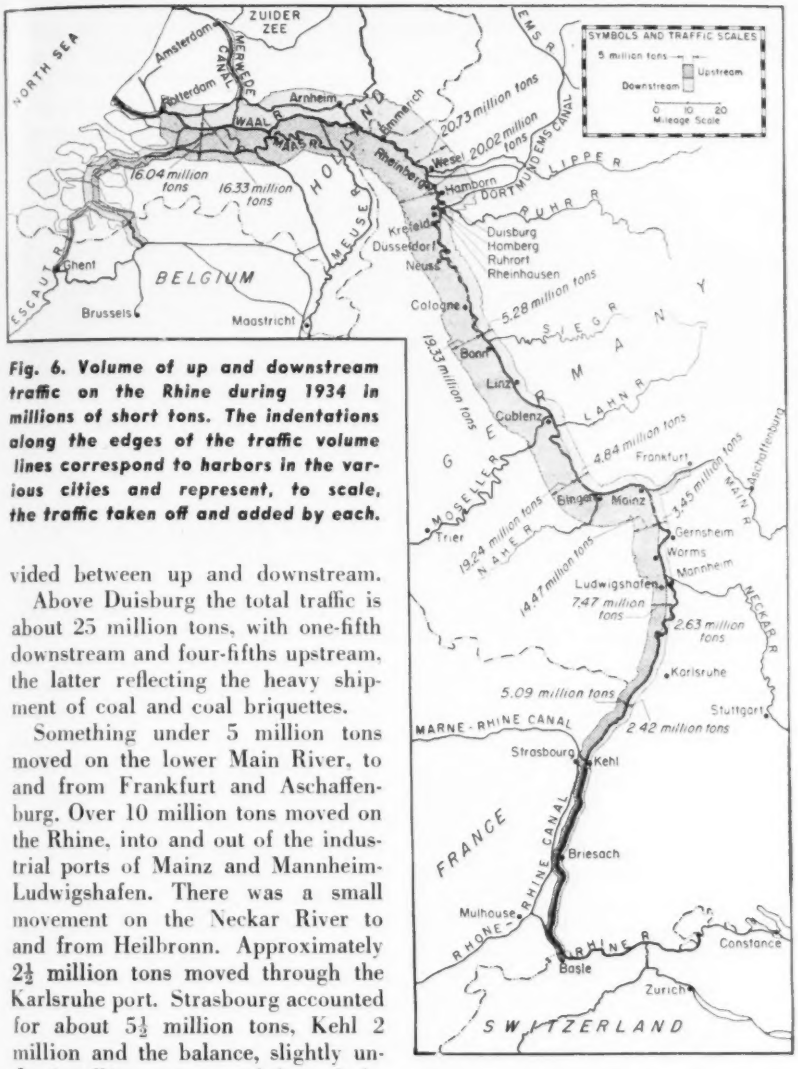

Fig. 6. Volume of up and downstream traffic on the Rhine during 1934 in millions of short tons. The indentations along the edges of the traffic volume lines correspond to harbors in the various cities and represent, to scale, the traffic taken off and added by each.

vided between up and downstream.

Above Duisburg the total traffic is about 25 million tons, with one-fifth downstream and four-fifths upstream, the latter reflecting the heavy shipment of coal and coal briquettes.

Something under 5 million tons moved on the lower Main River, to and from Frankfurt and Aschaffenburg. Over 10 million tons moved on the Rhine, into and out of the industrial ports of Mainz and Mannheim-Ludwigshafen. There was a small movement on the Neckar River to and from Heilbronn. Approximately 2½ million tons moved through the Karlsruhe port. Strasbourg accounted for about 5½ million tons, Kehl 2 million and the balance, slightly under 2 million tons, moved through the Swiss port of Basle.

Below Mannheim and above Duisburg the ratio of upstream to downstream traffic was about 4 to 1, whereas above Mannheim it became about 3 to 1 and above Strasbourg it was about 20 to 1. By 1938 this latter ratio was improved to about 12 to 1.

Rhine river craft

The types of traffic movement described in the preceding paragraphs have resulted in the development of several designs of special purpose craft. By far the largest traffic was in coal, and the principal carrier has been the so-called Rhine barge. Various sizes have been built, but the most common types range from 200 to 1800 tons cargo capacity, with a maximum size of 4000 tons. These barges have pointed bows and include a steering mechanism. They move by day, and tie to the bank at night. Night navigation has not been developed to any great extent.

Some of these barges were owned by individuals, but the greatest number was the property of shipping companies and the large corporations, particularly the coal mines. In 1934, large tonnage operated on the river was divided between Holland, Germany, Belgium, France and Switzerland as shown in Table 3. Holland and Germany controlled the major portion of the barge fleet.

Tow boats for moving barges were likewise divided between private ownership and large corporations. In addition, state ownership of tugs was customary on the German canals. There was considerable variation in size of tugs ranging from the small tow boat of perhaps 200 hp. to the four screw, diesel tow boat "Uri" owned and operated by the Swiss Navigation Co., of Basle, having 3600 hp. One large group of tow boats, largely German and French owned, is the so-called "paddle boat," a side-wheel type of approximately 1600 horse power. Unlike on the Mississippi, where barges are joined together and pushed as a raft ahead of the stern wheeler steamers, these Rhine side-wheelers pull their tows in a long file of three to as many as nine barges.

Rhine tugs would normally take barges of all nationalities as they became available, and balanced the books between the companies at intervals based on a ton-mile towing charge, varying with the reach of the river, the stage of the water and other conditions. The approximate total tug horse power controlled by each country in 1934 is also given in Table 3. Normal power units were steam, although an appreciable percent were diesel.

A third type of craft, which was developed to a considerable extent by the Swiss in the period following the first World War, was the so-called self-propelled boat. These were initially steam, but later types were diesel. Relatively high speed, they were used for carrying the more valuable cargo from the seaports to Switzerland.

In 1934, the Swiss owned twenty-seven of these craft, aggregating 12,723 tons, which increased to 102 and 54,936 tons by 1938. The capacity of these boats ranged from 350 to 1,000 tons, and some could make a round trip from Rotterdam to Basle and return in as little as two weeks. The other nations, especially the Dutch, also have some self-propells.

Connecting canals

Various connecting waterways were developed to interchange traffic with the Rhine system. At Wesel and Ruhrort there are canals joining with the canal system of north Germany, which reaches to the ports of Emden, Bremen, Bremerhaven and Hamburg. This canal system also extends across north Germany to Berlin, Stettin and Danzig, crossing the Weser, Elbe and Oder rivers in turn. However, largely because of the much longer time required for transport, this canal sys-

tem did not produce traffic in the ratio that it developed on the Rhine. In the open waters of the Rhine relatively fast movement was possible whereas in the canals movement was much slower and delays more frequent. There was, however, considerable interchange of barges, and it was not unusual to see a barge from Stettin or Danzig in the port of Mannheim or Strasbourg.

A long range development which has received considerable study in Germany, but on which little construction has been accomplished, is a project to connect the Rhine and the Danube. It is based on the desire to establish a waterway through which the oil, petroleum products and grains of eastern Europe could be shipped. A small canal accomplishes this connection at present, but it is extremely limited in capacity, and the time of passage is long. Such a canal would also connect the rich agricultural area of Bavaria to the industrial Rhineland. Its cost, however, is out of proportion to the benefits immediately obtainable, and construction will undoubtedly be deferred for many years.

Table 2—TRAFFIC ON RHINE RIVER, U S ZONE PORTS*

December 1946–April 1947

Month 1946	Coal Unloaded, Upstream Movement Tons	Total Cargo Unloaded Tons
December	179,206	333,272
1947		
January	99,176	145,848
February	†36,227	37,230
March	96,495	210,241
April	302,119	633,093

†River blocked by ice.
*Ports Included: Mannheim, Karlsruhe, Wursburg, Frankfurt, Aschaffenburg, Wiesbaden, Heilbronn.

Navigation advantages

The Rhine is normally open to navigation throughout the year, although during low water periods loadings must be reduced. Below Duisburg-Ruhrort this reduction averages 10 percent of the barge capacity during one month of the year, while upstream it ranges from 10 to 40 percent over an average of three months. The river is closed to traffic about one year in five by ice gorges, but only for periods of from two weeks to two months.

Variation in stage from high to low water ranges from about 13 ft. at Strasbourg to 28 ft. at Duisburg, which is generally less than the variation on either the Ohio or Mississippi rivers. Consequently, terminal facilities have been easier to develop, and have been made much more permanent than is possible on the American rivers. Through the major portion of the navigable reach of the Rhine the banks are fixed (often both banks are paved), and it is not unusual to see a section several miles in length with cranes, docks and all types of unloading equipment permanently constructed, literally on the banks of the river. This permits loading and unloading to be distributed over a considerable length of river bank, and avoids the terminal congestion which frequently exists in the U. S. ports where favorable unloading points are limited in extent. It also permits easy access to rail connections from the docks. Another advantage results from the fact that the amount of sediment carried by the river is generally small, so that the ports are not subject to much silting.

War's effect on the Rhine

During World War II, the Germans made extensive use of the river for internal movement. Although barges were fairly vulnerable to bombing, it was difficult for Allied bombers to determine if and when they were a profitable target, and consequently they were not attacked as much as rail traffic. They could also move at night, although night movements are not normal on the Rhine.

At no time during the war, prior to the invasion of Germany by the Allies when all bridges were blown by the retreating Germans, was navigation blocked for any appreciable period, except in the reach above Kembs where the dam was knocked out by the British early in the war. Navigation was restored at Kembs in 1941, but blocked again in 1944 when the dam was partially destroyed by German demolitions.

At the cessation of hostilities in May, 1945, the Rhine was completely blocked with demolished bridges, temporary military bridges, and sunken craft. The Rhine fleet was largely scattered or destroyed. Some tugs and barges had escaped to the Main and Neckar Rivers, but were immobilized in these tributaries

Table 3—COMPOSITION OF THE RHINE FLEET IN 1934

TYPE OF CRAFT	Switzerland			France			Germany			Holland			Belgium			Totals		
	No.	HP	Tons	No.	HP	Tons	No.	HP	Tons	No.	HP	Tons	No.	HP	Tons	No.	HP	Tons
Tugs or Tow boats																		
(a) Steam (Paddle)	4	4,850	.....	25	29,990	.....	79	88,265	.....	6	8,950	.....	3	3,825	.....	117	135,880	.....
(b) Steam (Screw)	1	250	.....	63	20,165	.....	295	81,864	.....	580	140,301	.....	30	7,200	.....	969	249,780	.....
(c) Motor (Screw Diesel)	7	1,865	.....	.....	.....	.....	41	11,565	.....	87	121,134	.....	.....	.....	.....	135	25,564	.....
Totals	12	6,965	.....	88	50,155	.....	415	181,694	.....	673	165,385	.....	33	11,025	.....	1,221	411,224	.....
Barges																		
Totals	7	.....	79,191	298	.....	362,722	2,205	.....	1,973,819	5,089	.....	3,431,254	1,214	.....	762,765	8,873	.....	6,609,751
Self Propelled																		
(a) Steam	.....	.....	.....	.....	.....	.....	32	11,808	19,704	58	18,500	39,190	.....	.....	.....	90	30,308	58,894
(b) Diesel	27	9,022	12,723	.....	.....	.....	129	18,578	46,915	1,360	102,967	281,674	120	.....	36,800	1,636	130,567	378,112
Totals	27	9,022	12,723	.....	.....	.....	161	30,386	66,619	1,418	121,467	320,864	120	.....	36,800	1,726	160,875	437,006

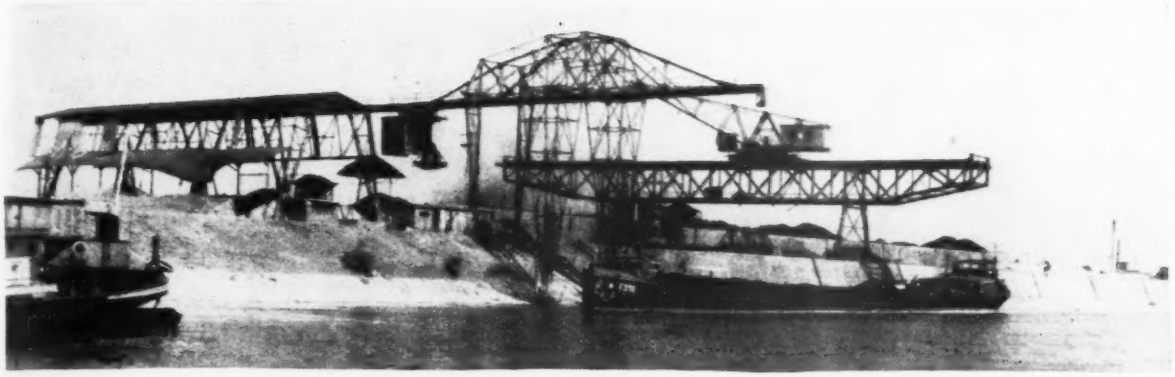

Fig. 7. Typical coal unloading port between Worms and Mannheim. Coal can be transferred from barge direct to rail cars or into storage.

above demolished bridges or emergency military structures. The organizations which had conducted the engineering and maintenance work on the river itself were also largely disorganized or destroyed, as were the transportation companies.

By September, 1945, a ship channel had been cleared although it was still hazardous in many places. Concentrating on the locations which presented the greatest difficulties, however, work continued, and it is anticipated that a channel approximating pre-war as to dimensions will be cleared by the end of the 1947 season.

Postwar operations on the river

In Switzerland, France, Belgium and Holland, the pre-war river organizations were re-established in 1945, and river work resumed. These organizations re-surveyed the channels, resumed normal maintenance and removed debris. In addition, the repair of the Kembs dam, to re-establish navigation to Basle, was undertaken by the Swiss during late 1945. Final repairs were completed toward the end of that year.

Within Germany each occupying power initially set up a temporary river maintenance organization under the army. As rapidly as possible, however, the old German waterways offices were re-established, and all river maintenance was turned over to these offices under army, and later, military government supervision. This was done individually by each of the occupying forces in 1945, but in the spring of 1946 their efforts were coordinated and a tripartite (U. S.-British-French) control of German offices was established. Later a co-ordinated German organization was formed under tripartite supervision.

To restore traffic on the Rhine, the scattered fleet of barges and tow boats had, of course, to be reassembled and refitted. Such portions as were intact in Holland, Belgium or Switzerland were reorganized and prepared for operation by their owners. The French, Dutch, Belgium and Swiss boats in the Rhine, Main and Neckar Rivers were also returned to their owners as rapidly as they could be properly identified.

A program of salvage and repair was organized by each occupation power in its zone, utilizing German shipyards and German salvage crews. German vessels were operated initially under the control of the zone in which they were found, but in the winter of 1945-46, German shipping organizations were re-established, and operation of German vessels turned over to them in the U. S. and British Zones. In the summer of 1946, a combined German organization was formed, and tugs and barges of the U. S. and British Zones operated as a pool to move internal German traffic. These crafts are not yet permitted to move to the Dutch and Belgian seaports, nor are the Dutch and Belgian boats included in the U. S.-British pool operation. The French retain separate control of their own barges and of German barges in their zone. The Swiss, Belgians and Dutch operate their own fleets and assist each other and the French.

Operation was actually resumed in the fall of 1945, but was limited principally to downstream traffic from Duisburg to the seaports, with a small coal movement upstream to the U. S. Zone. During the winter of 1945-46, this upstream traffic was expanded and extended. Coal movement was given priority and, by early spring, considerable movement from Duisburg to ports in the U. S. and French Zones was established. This traffic reached 268,000 tons to the U. S. Zone alone, in May, 1946. Some traffic, from the seaports to Strasbourg developed, including considerable movement of petroleum products, flour and grains. In the spring of 1946, this traffic was extended to Basle with the opening of Kembs lock.

The coal traffic was further expanded during the summer of 1946 and considerable miscellaneous cargo moved. Table 2 shows the approximate movements by months, from December, 1946 to April, 1947, to ports in the U. S. Zone.

Although the river is physically carrying commerce and a very appreciable traffic has developed, trade with Germany is stifled until some stable currency exchange is established. The fleets, reassembled and repaired, are capable of handling more cargo than is presently offered. The greatest deficiency is in tug and tow boat power, where large losses occurred in the war, and where the repaired craft are not in prime operating condition.

Today, however, the Rhine is open for navigation. Its channel from Basle to the Dutch and Belgian ports is sufficiently cleared of obstacles to pass tow boats and barges. Its ports are rising from their rubble and are handling freight. With low water depths approximating prewar standards, only bridge clearances remain restricted.

Slippery bituminous pavement is made skid-proof by applying a binder over which rock asphalt is spread by a drag.

Skid-Proofing Kentucky Highways

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***Contents in Brief**—Traction characteristics, practically skid-proof in nature, are added to old, slippery bituminous pavement surfaces on Kentucky highways at relatively little cost. Two light applications of Kentucky sandstone rock asphalt applied to a previously placed prime coat of medium curing asphalt, dragged smooth, and compacted under traffic provides a non-skid surface that meets with increasing approval by the motorist.*

FOR MANY YEARS, the presence of excess bitumen on the surface of black-top pavements has been a problem for the maintenance engineer. Much of this has been caused by excess bituminous material used in patching operations, while some is due to lack of uniformity in placing the surface materials. This slippery condition is accentuated in rainy weather.

One of the methods evolved in the past to "skid-proof" these slippery spots was predicated on the use of an additional amount of bituminous material to hold the cover material and bind it to the road. Another was to press heated aggregate into the road surface with a heavy roller. A third method was to burn off the excess bitumen and reseal with a light treatment of bitumen and chips.

Old remedies were temporary

These remedies only solved the problem temporarily, however, and afterwards there was more bitumen on the surface than before the treatment was given. Kentucky, with great quantities of limestone readily available, was one of the pioneer states in the construction of turnpikes. With the increase of automobile traffic, a great many of these turnpikes were improved with a black-top surface. So the maintenance engineers were especially concerned with the eradication of these spots which were slippery on account of an excess of bitumen on the surface.

In several localities in Kentucky, there are deposits of natural sandstone rock asphalt. This material is composed of sharp angular quartz sand impregnated with 6.2 to 8.5 percent bitumen. When crushed, it is dull black in color and the particles have a tendency to stick together. It makes a dense road surface and, due to the presence of the sharp angular quartz sand, is practically skid-proof. It was found through experiments that a light coating of this material could be applied to a road surface, making it skid-proof for several years.

The current method developed by the Maintenance Division of the Kentucky State Highway Department in making its slippery bituminous pave-

ment practically skid-proof has been simplified to a degree requiring a minimum of equipment and a relatively small crew.

For the average job a crew of twelve is needed to operate the equipment, which includes a steam boiler for heating the asphalt in the railroad cars, and a clamshell for unloading it. In addition there are one water truck; three medium size trucks for hauling the asphalt; a pressure distributor, usually mounted on a truck chassis; one spreader; and a truck with metal drag. In some instances a lightweight pneumatic-tired roller is used for initial compaction of the newly laid asphalt.

First operation is to thoroughly clean the old pavement by brooming, sweeping or other mechanical means. After a stretch of pavement has been cleaned and permitted to become thoroughly dry, a prime coat of light MC-1 or MC-2 asphalt is applied in the form of a fine spray, or mist, at the rate of 0.05 to 0.10 gal. per sq. yd. This is done by driving a distributor down the road at about 25 m.p.h. with the spray bar set about 10 ft. above the pavement.

It is necessary to block the road to traffic during this brief operation to prevent passing cars from being coated with the liquid asphalt. However, all other phases of this work are performed without interruption to traffic which is permitted to travel the highway at low speeds while the work is in progress.

It is necessary at all times for the distributor to travel into the wind, and an entire 20-ft. pavement can be tack-coated during one passage of the distributor by shifting the spray-bar to compensate for slight variations of the wind.

After the application of liquid asphalt has become "tacky," which usually is expedited by light rolling with empty trucks or a pneumatic-tired roller, the natural sandstone rock asphalt is applied at a rate of 6 to 10 lb. per sq. yd. Best method of applying the asphalt, which has been heated to from 175 to 200 deg. F., is by means of an ordinary rotating sand spreader mounted under the tailgate of an end-dump truck.

Usually the sandstone asphalt is applied to one traffic lane at a time to cause a minimum of interference to traffic. It is always applied in two applications. After each application, the fresh asphalt is dragged with a metal drag made by fastening sections of wire mesh guardrail to pieces of 2x4-in. hardwood about 10 ft. long. The drag is pulled by a truck at about 15 m.p.h. and it serves to pulverize any small lumps of the rock asphalt and to distribute it more evenly.

Using state maintenance forces, the average cost of skid-proofing old, slippery bituminous pavement in Kentucky is $100 per mile per pound of sandstone asphalt application or, in other words, from $600 to $1,000 per mile of two-lane pavement.

Perhaps the two most important requirements for producing a satisfactory job are (1) to secure a well-steamed, uniformly heated, lump-free asphalt and (2) perform the work during the hot, dry summer months.

British Experiment with Sowing Grass Under Thin Bituminous Emulsion

Experiments conducted in England during the war to speed the germination and growth of grass on advanced landing fields at Headcorn, Kent, gave such encouraging results that further experiments were carried out more recently in southwest Middlesex. An account of these latter experiments is given by H. W. Jarvis, divisional surveyor, Middlesex County Council, in the Jan. 17, 1947, issue of *The Surveyor*, London. Excerpts from that report are given below.

The method used at Headcorn was to incorporate a proprietary brand of peat in the soil, sow grass seed in the normal way, cover with ⅛ in. sand, spray with a proprietary brand of non-toxic bitumen emulsion, cover with another ⅛ in. sand, and roll with a heavy hand-roller.

Owing to the remarkable results obtained at Headcorn, it was felt that further investigation was justified, but that the stimulus to the rapid germination of the grass seed, under practically any weather condition, was due to the film of bituminous emulsion rather than to the incorporation of peat. In almost every case, soils had to be brought to the site before sowing could be carried out, and this was top soil from the site of an extension to a gravel pit near the river Thames. This new soil had to be well consolidated and levelled with repeated rolling and raking during dry weather. As the part of Middlesex in which this work took place has a gravel subsoil, no extra drainage was needed, but it is vitally important to provide adequate drainage on heavy or clay soils.

When the plot had been made as firm and level as possible, the surface was very lightly raked over to obtain about ½ in. of fine tilth, into which the grass seed was raked before the first layer of sand was applied. Emulsion from six different manufacturers was used. The best grade seemed to be that containing 55 percent bitumen sprayed at the rate of 6-7 sq. yd. to the gallon, using a normal cold emulsion sprayer.

This bituminous film on the soil has a twofold effect: First, it conserves any heat that may be present at the time of sowing, and secondly, by capillary action, it draws up the moisture to the surface from a considerable depth, thus providing warmth and moisture, the two essential agents for speedy germination and subsequent growth.

It was observed that where the film of bitumen was sprayed thicker than that described above, the grass shoots took a much longer time to break through the surface.

It is advisable to use clean, sharp sand both above and below the film of emulsion, as the sand below the emulsion splits up the tufts of new grass into separate shoots, making a more even sward. The sand above the emulsion amalgamates with the film and makes this crack up more easily under the pressure of the growing grass.

Experiments showed that the minimum quantity of seed to obtain an even sward that can be thrown open to the general public immediately after its first cut was 2 oz. per sq. yd.

One remarkable result in this form of sowing is the complete freedom from annual weeds. Air-borne seeds are unable to germinate, as their roots cannot pierce the bitumen.

RESEARCH LABORATORIES OF THE RECLAMATION BUREAU—PART III.

What the Engineering Geologist Does

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William H. Irwin — Assistant Chief Geologist
Bureau of Reclamation, Denver, Colo.

***Contents in Brief**—Participation of geologists in engineering investigations is essential to the soundest and most expeditious design of engineering structures. This is particularly the case with reclamation works, the success of which depends in large measure upon their adaptation to natural site conditions. It is with the interpretation of these conditions—involving expert knowledge of rocks, soil, groundwater and topography—that the geologist is concerned. This article provides many examples of how the geologist applies his skills in the solution of practical engineering and construction problems. Other articles in this series appeared in the issues of Sept. 18, vol. p. 381 and Oct. 2, vol. p. 472.*

AN ENGINEERING structure, such as a dam, tunnel, canal, pumping plant, or powerhouse—the type of structure with which the Bureau of Reclamation is primarily concerned—can be no better than the foundation upon which it rests and the materials of which it is made.

Adaptation to natural site conditions through appropriate design and construction, will determine in large measure the effectiveness of such structures. These conditions require expert interpretation. And inasmuch as they involve primarily the rocks, soil, groundwater and topography—things which are the stock-in-trade of the geologist—it is natural that the geologist assume primary responsibility for their interpretation.

Application of geological knowledge to engineering practice has always paved the way to more effective and lower-cost engineering works. Today, the need for comprehensive geologic treatment is enhanced by the increasing size and complexity of our structures as well as the indubitable fact that these structures must be adapted to poorer sites because the better sites are already in use. Of the several hundred possible damsites examined by the bureau in the past two or three years, only about 150 were worth additional investigation, and of this number less than 50 have good hard-rock foundations.

Out of the need that the designer and the construction engineer have the best and most specific information obtainable about the natural conditions to which they must adapt their structures, there has developed over the last two decades a new breed of geologist—the engineering geologist—who is not concerned solely with faults, folds, or their origins, but with the interpretation of their engineering implications. He must first study the pure geology of a structure site, but his primary concern is to interpret this and supply answers to such questions as: On what slopes will this material safely stand? Will this foundation settle, and how much, and how rapidly? Will these rocks successfully withstand the specific stresses imposed by specific structures? Will this reservoir leak? Will this cliff stand intact or fail by landslides?

Fig. 1. Interpretation of the engineering implications of subsurface conditions is one of the tasks for this "new breed of geologist".

The engineering geologist must apply this practical approach to a miscellany of problems. For example, the drainage of water-logged agricultural land was accomplished when the geologic causes of the water-logging were disclosed. Again, the slumping of a canal traversing a steep slope was found to be caused by seepage of canal water and was cured by the installation of an impervious lining. Deterioration of a concrete structure was proved, by a combination of field and laboratory studies, to be the result of deleterious chemical attack by sulfates contained in the shale foundation; as a result of this diagnosis, sulphate-resisting cement was used in the repair.

Functions of engineering geology

The functions of engineering geology are to ascertain what information the engineer will require concerning natural site conditions, to translate these need into appropriate programs of investigation, to coordinate the field, office and laboratory aspects of

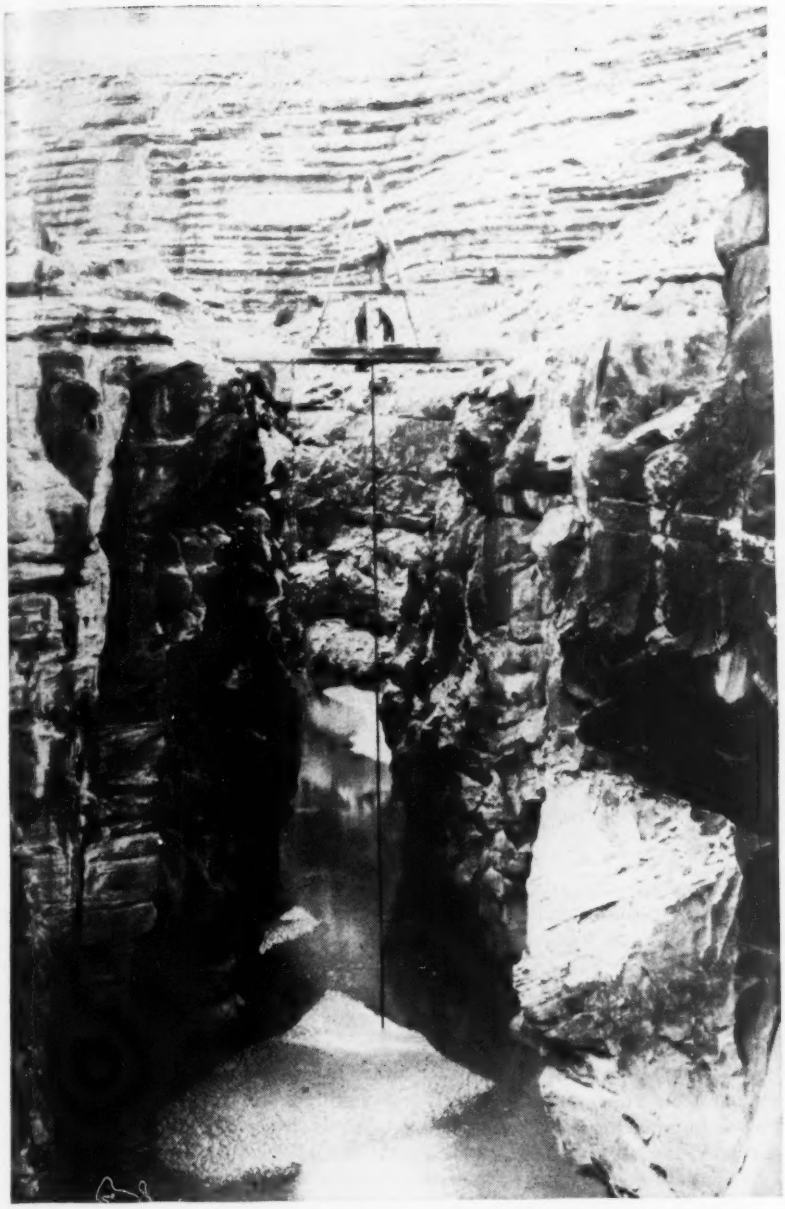

Fig. 2. Diamond-drilling operation on the Little Colorado River illustrates the terrain difficulties frequently encountered in the investigation of damsites. This exploration is being made to determine thickness of river fill and depth to bedrock at the Coconino damsite.

these programs, to obtain and interpret the results and to assemble them into the form most usable by the engineer.

In the performance of these functions all the technical aids and implements of the related sciences must be available if the information required by the design and construction engineers is to be assembled most completely, clearly, and quantitatively. Thus the existence of an old landslide in a damsite area may be recognized quickly through the interpretation of aerial photographs; differential thermal, X-ray and microchemical analyses are necessary aids to the detection of swelling clays or mineral materials that will weaken under the high groundwater level of a new reservoir and the weight of a high dam; or geophysics in combination with a small amount of drilling may quickly indicate the depth of overburden or the configuration of a buried bedrock floor in lieu of extensive drilling which is slow and costly. In fact, the specialized assistance of the chemical or physical sciences can be applied profitably to the solution of most problems in engineering geology.

In the Bureau of Reclamation, engineering geologists are placed on the staff of the chief engineer in the division of engineering and geological control and research, as well as in the major regional and project offices, to serve the engineers by formulating and reviewing programs of field exploration and interpreting the results. They include groups of geologic specialists in groundwater, geophysics and research, as well as materials-engineers who specialize in the exploration for construction materials such as earth materials, riprap, and concrete aggregate.

These specialist groups are trained to coordinate their work with the progress of the engineering operations and may associate themselves with any problem. Thus, to cite only one example, combined geologic and groundwater investigations revealed that the grout curtain originally considered necessary for the South Dam foundation in the Columbia River basin could be reduced by half without permitting undue leakage through the foundation rock.

Petrographic analysis important

The Reclamation Bureau has well-equipped petrographic and earth-materials laboratories which permit field problems to be carried to the laboratory for precise final analysis. The work of these laboratories in the study of construction materials has been described in a preceding article (*ENR* Sept. 18, vol. p. 381), but an equally important service relates to that great variety of problems, research or routine, involved in the analysis of foundations, leakage, drainage and structural stability.

For instance, the engineering feasibility of a project in southern Colorado hinged upon the porosity and permeability of the sediments which covered the reservoir floor; Counsellor Damsite in the same region was abandoned largely because of the threat of landslides on the abutments; the design of dams in parts of Kansas and Nebraska requires comprehensive analysis of the potential settlement of the silty soils of the area,

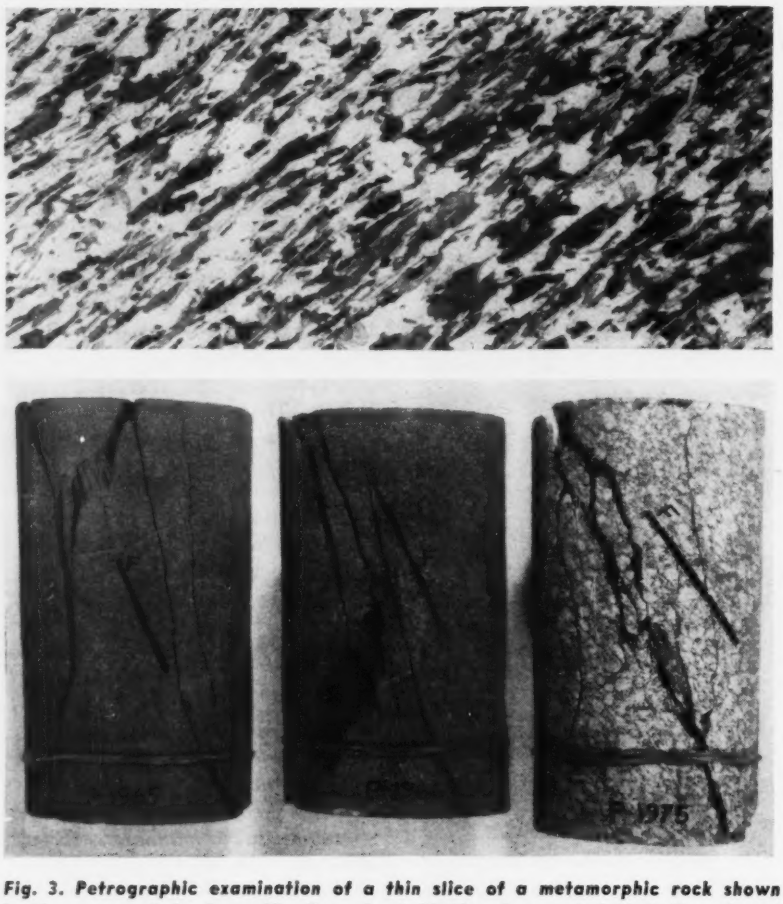

Fig. 3. Petrographic examination of a thin slice of a metamorphic rock shown in the upper photo (magnification about 50 times) revealed that the mineral grains were arranged in parallel planes and led to the prediction that the rock would fail along these planes. Crushing tests conducted on cores of this rock (lower photo) confirmed this prediction. The line marked F on the side of the cores was the predicted line of failure.

when subjected to loading and saturation.

Such problems usually require petrographic identification of the materials involved, microscopic and micro-chemical study, and a great variety of routine or special tests for which the petrographic and earth-materials laboratories are fully equipped. In addition, the various specialized facilities of the other units are available for any chemical, physical, hydraulic, mathematical or other research or testing aid which investigational problems may require.

How projects are handled

Normally the development of a Bureau of Reclamation project from the earliest preliminary studies to the operation of the completed structure progresses sequentially through the following successive stages: Reconnaissance; selection; preliminary design, and estimate; final design and specification; construction; operation and maintenance.

Reconnaissance—In this stage a large number of possible sites may be examined to determine the most promising locations for structures and the kind of geological and engineering problems that different sites may be expected to impose. For instance, in the proposed Blue-South Platte transmountain water diversion project in Colorado, engineering and geological reconnaissance disclosed a large number of possible tunnel lines, identified the kinds of rock and the major faults that the various lines would traverse. It was then concluded that: (a) the transmountain diversion was practicable, (b) of all the alternatives, certain lines were far less difficult than the others, and (c) more detailed explorations should be concentrated in specific areas of geological uncertainty on one or two of the most favorable lines.

Similarly, reconnaissance studies along the Rio Grande near the Colorado-New Mexico boundary indicated one damsite to be the most promising, provided later studies could prove that: (1) excessive loss of water would not result through bank storage in the lava rock in the reservoir; and (2) similar lava in the left abutment could be grouted to prevent excessive leakage around the dam.

Selection—When the choice is narrowed to a few most promising sites, sufficient additional exploration is performed to permit elimination of alternative sites, a clarification of the geological conditions and of the engineering problems which those conditions may present, and to permit rough cost studies for testing a project's probable economic feasibility.

The proposed Magote reservoir site was eliminated from a Colorado project in favor of other alternatives in part because investigation disclosed that recharge of unsaturated sediments on the reservoir floor probably would have absorbed the entire flow of the river for a number of years. On a New Mexico project successful rehabilitation of an old reservoir was shown to be economically unfeasible due to the cavernous condition of the underlying rock, and the conclusion was reached that the required water storage would have to be obtained by other means. Investigations of possible damsites on the Conejos River in southern Colorado, where the river valley is underlain by thick accumulations of sand and gravel, demonstrated that a choice between two alternative sites would be largely governed by the permeabilities of the sands and gravels that underlay them. Accordingly, the selection-stage investigations were concentrated on field and laboratory permeability tests.

Construction of Boysen Dam in Wyoming requires the relocation of a railroad through a narrow canyon. A relocation route tentatively chosen by reconnaissance, involved many deep open cuts and ten short tunnels, and was replaced by a single long tunnel on the basis of more detailed studies. They revealed that the single 7,100-ft. tunnel would be simpler to build, cheaper to maintain, and would avoid potentially hazardous rockfalls and landslides.

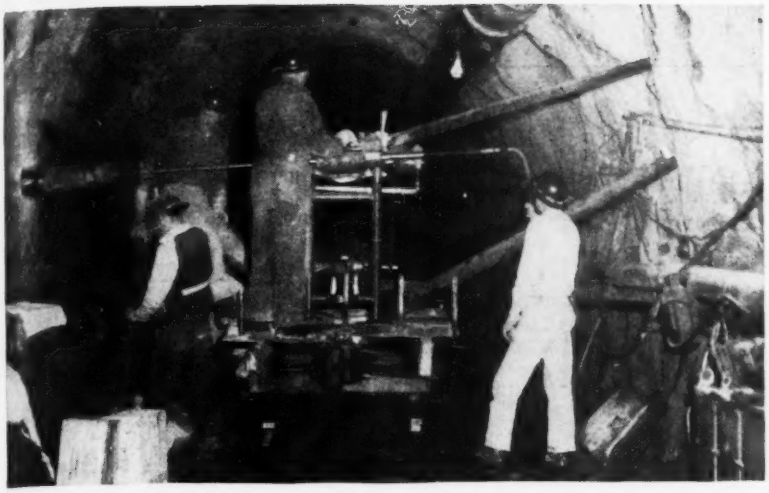

Fig. 4. Rock stresses in the walls of the Prospect Tunnel are determined by cementing one-inch electric strain-gag rosettes on the rock and then relieving the stress by drilling around the gages with a 6-in dia diamond core drill. This tunnel, now being lined, forms part of the Colorado-Big Thompson project.

Preliminary design and estimate—In this stage the selected site is subjected to supplementary exploration sufficient to yield the data for dependable preliminary design and cost estimate, to resolve any remaining major uncertainties and to permit an assured choice to be made of the type of structure most appropriate to the natural conditions imposed by the site.

Thus the consideration of the position of joint systems, old shear planes and other directional elements of weakness in abutment rock have served as partial bases for favoring gravity instead of arch dams. In other instances, as at several damsites in Nebraska and in North and South Dakota, critical design decisions depended upon whether weak shales, poorly cemented sands and silty materials in the foundations would be sufficiently competent or would have to be removed at great expense, and whether these materials, if removed, could be used in the embankments.

Final design and specifications—Detailed and comprehensive explorations are performed at this stage to permit final design and the completion of specifications. Thus, in the case of the Tracy pumping plant for the Central Valley project in California, a large structure to be placed in a deep cut in clay formations, investigations in this stage were concentrated on: (a) determination of excavation slopes best combining economy and safety; (b) study of the groundwater inflow to be expected during construction; and (c) ascertaining whether a pile foundation would be required and, if so, what type of pile would be preferable.

The investigations involved detailed field geologic study and sampling, field observations of groundwater, observation of structures built on similar materials in the same region, and comprehensive laboratory testing and analysis, including triaxial shear, pore pressure, permeability and corrosion studies. These studies led to provision in the final plans for 4:1 slopes and steel piles. It was concluded that only moderate inflows of groundwater would be encountered and that cathodic or other protection would not be necessary to prevent corrosion of the piling.

Construction—In this stage investigations continue as excavations progress and the foundation is exposed, so that unforeseen conditions may be quickly recognized, and to establish a permanent geological record. The question was asked whether piles being driven in the foundation of the C-Line pumping plant in Idaho were actually improving the bearing capacity of the foundation. Seeking for the answer a study of the foundation materials revealed that the foundation was being weakened by pile-driving. Elimination of the piles made possible a better foundation at a reduced cost.

Laboratory techniques and equipment are used frequently in the field for the solution of construction problems. For example, the design of a pressure tunnel on the Colorado-Big Thompson transmountain diversion called for the use of 1,500,000 lb. of reinforcing steel in the concrete lining. Excavation disclosed that the rock was of high quality and the need for this reinforcement was questioned. The solution of the problem depended on determination of the actual state of stress of the rock at the tunnel walls. This determination was made by the group specializing in stress analysis who cemented one-inch electric strain-gage rosettes on the wall and then drilled around the gages with a 6-in. dia. diamond core-drill until the stress was relieved. Study of readings taken before and after drilling revealed that the tunnel walls were under compression in all directions and about two-thirds of the proposed reinforcement could be safely eliminated.

Operation and maintenance—In this stage investigations are of a miscellaneous character, because of the great variety of operation and maintenance problems.

A dramatic example of the role of field geologic, petrographic and related laboratory studies in determining corrective foundation treatment for the Malheur Siphon to avert extensive damage and possible failure is to be described in a later article in this series. Another example of an operation and maintenance problem involved the numerous major landslides that developed in silty formations standing as high cliffs bordering the 150-mi. long reservoir created by Grand Coulee Dam. Farms, highways and portions of a railroad were menaced. Detailed field geologic studies and laboratory investigations of the shearing strength, porewater pressure, mineralogic composition and other properties of the silt provided the criteria by which the probable location and extent of future landslide action could be determined. Thus a rational basis was supplied for determining the additional right-of-way purchases necessary to secure the safety of life and property.

Each of the stages enumerated above, preceeding from the cursory to the highly detailed, has its own immediate objectives, and in each stage the procedures of investigation must be accommodated to the special prob-

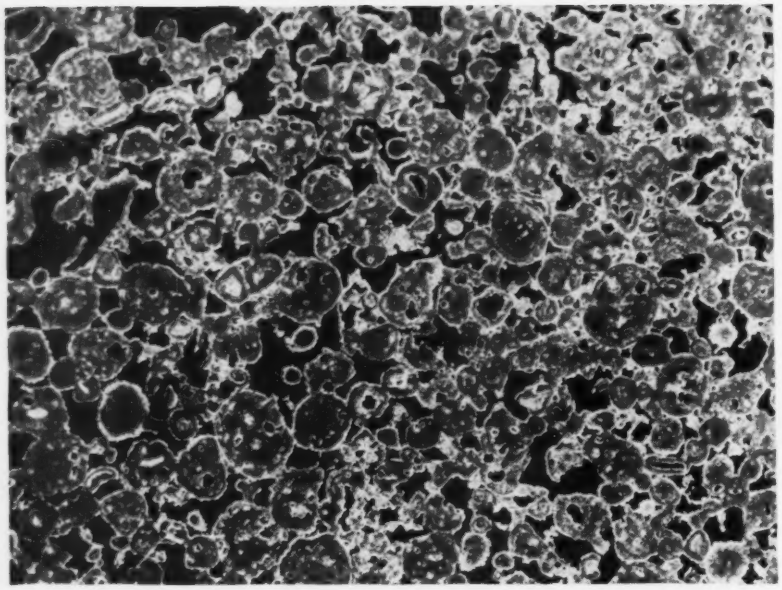

Fig. 5. Photograph (enlarged 40 times) of a thin slice of a limestone to illustrate the internal structure, size and distribution of pore spaces and mineral composition. Microscopic study of such factors is important in evaluating the strength and durability of a rock.

lems of the site. To obtain the information required, the routine operations of drilling, test-pitting, and studies of the surface geology must be supplemented by field tests for bearing capacity, consolidation and settlement, permeability or slope stability, by geophysical investigations, or by laboratory tests or research involving petrography, chemistry, physics, hydraulics, electronics, structural analysis, or any other of the sciences applicable to engineering.

Similar procedures for other problems

Although this discussion has been directed specifically to studies of foundations, the investigations of construction materials, such as earth materials, concrete aggregate, and riprap develop progressively through the same sequential stages and every scientific tool is used as occasion demands.

Thus, the groundwater geologist may interpret the conditions of a materials source from the standpoint of unwatering of borrow pits or in connection with pre-irrigation of earth materials by which the moisture content of material for use in embankments may be raised to the proper amount. Geophysical exploration may save many feet of boring or test-pitting otherwise necessary to determine the depth or configuration of the bedrock floor. Interpretation of aerial photographs in the earliest reconnaissance stages may save weeks of tedious and expensive field investigation by establishing in advance of field work the localities where promising materials deposits may lie, in contrast to barren areas in which it would be fruitless to explore.

The geologist has much to contribute, both in the field and in the laboratory, to the investigation of construction materials. At Newton Dam in Utah a decision was required as to whether a premium need be paid to secure riprap from a distant source or whether a nearby softer rock could be utilized. Coordinated field geologic and laboratory tests, especially petrographic analysis, supplied the answer: The softer rock, although inferior to that of the distant source, was good enough and cheaper to secure.

In the early stages of investigations, particularly in advance of detailed testing and exploration, when inventories are being made of a large number of possible materials sources, and the merits of various alternative sources are being weighed, the geologist's knowledge of the relation between the typical shape of terraces, benches and other special topographic forms, the materials in them and their position with respect to rivers, mountains and plains is a fruitful source of valuable data.

Thus, according to the results of preliminary materials investigations for Kortes Dam in Wyoming, no local source of sand and gravel for concrete existed; the manufacture of coarse aggregate by crushing granite from the damsite area and importation of sand was thought to be an inevitable alternative. A geologist, using his knowledge of the behavior of streams and information on the geologic history of the area was able to locate an acceptable deposit of natural stream sand and gravel close to the dam.

Geologic studies are no luxury

It is becoming increasingly recognized that geological participation in engineering investigations is not a luxury, but is essential to the soundest and most expeditious design of engineering structures. Geology is a means toward actual dollars and cents savings. For example, the decision to leave a 19-mi. stretch of the Friant-Kern Canal unlined, made possible by geologic and field permeability studies, saved an estimated $2,000,000.

The possibilities for such economies are greatly increased when the investigator has at his disposal the whole gamut of specialized auxiliary services in the field, office, and laboratory, such as the Bureau of Reclamation has assembled for his use. But the tangible dollars and cents savings which result from adequate geologic participation in investigation programs are by no means the true measure of the geologist's contribution; his major contribution lies in the avoidance of costly mistakes and the promotion, through a better understanding of site conditions, lower-cost and more efficient final structures.

These latter contributions defy specific evaluation—especially when, as in the Bureau of Reclamation, the geologist is so closely geared to and intertwined with the whole of the engineering organization that his individual contributions may not be separately distinguishable in the final result.

The fourth article in the series, telling how theoretical and practical development are subjected to critical analysis in the field and laboratory, will appear in a forthcoming issue.

Fume Removal and Ventilation of Industrial Buildings

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***Contents in Brief**—Since air exhausted in ventilating an industrial building must be replaced by an equal volume of treated fresh air, the quantity removed should be kept to a minimum consistent with ventilation requirements and should contain a maximum of impurities. The fresh air should be distributed over the entire floor at low velocities to avoid drafts. Quantities needed for good ventilation vary from 3 to 15 complete changes per hour, assuming local hood exhaust in severe cases.*

BEFORE black-out plants of wartime experience could be built the problem of ventilating them had to be solved. Admittedly, this is a rather extreme example of the interdependence of architectural and structural design and ventilation, but it can be augmented by many cases in which mill buildings were constructed with working conditions that would be unendurable were it not for provisions made for fume removal.

Thus, a knowledge of the principles of ventilating industrial buildings is helpful in the planning of new structures.

The removal of fume and smoke is a frequent problem in industrial plants, and the solution varies according to the particular nature of the source of contamination. When the offending operation can be effectively isolated, as in a separate small room or under an exhaust hood, high efficiency of exhaust is possible. Relatively small quantities of air may carry away large amounts of contaminant in a concentrated condition. However, in the heavy industries, it is frequently impossible to isolate the sources of contamination, and an entire mill building must be considered for fume removal. In these cases, too, maximum concentration of contamination in the exhaust, with resulting efficiency of operation, is desirable.

By maintaining exhaust at maximum concentration, less air needs to be removed and consequently, less replacement air is necessary. Since every cubic foot of air exhausted in winter weather must be replaced by a cubic foot of air heated to mill temperature, maximum efficiency of exhaust is reflected directly back to the boiler house as pounds of fuel saved. (It takes two boiler horsepower or 66,000 Btu. per hr. to heat 1,000 cfm. of air from 0 deg. F. outside temperature to 60 deg. F. inside plant temperature.)

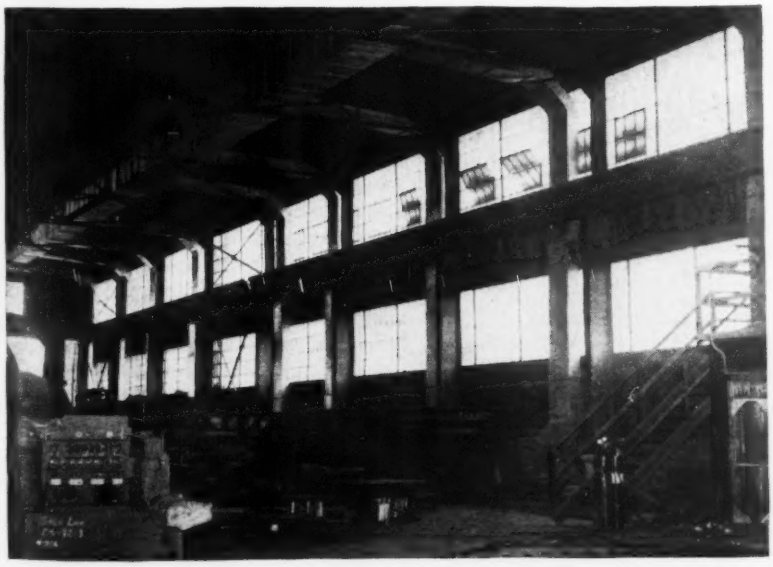

Fig. 1. Typical duct distribution system for replacement air in a large industrial building. Sheet metal downcomers are designed not to protrude beyond crane columns. Note flared outlet at right.

Normal air movement

Before attempting to evaluate the effect of mechanical or forced ventilation for a large mill building, the normal air movement should be predicted. Then, through utilization of these natural air currents in the design of the ventilating and exhaust system, full efficiency of operation can be achieved.

In Fig. 2a is shown a cross section of a typical mill building in which heat-producing processes, energy thrown off by machinery and heat radiated by people at floor level tend to warm the air, causing it to rise toward the roof. The exposed roof cools it, increasing its density so that it tends to drop back down—not vertically, since that would interfere with the rising current—but along the sides of the building. Here, further cooling by the walls causes this descending air to become heavier and

thus drop even faster. At the floor, these currents are again warmed and continue their path to the roof. Naturally, this gravity circulation within the building is much more pronounced in winter than in summer due to the greater cooling effect of the roof and walls.

Fumes resulting from heat-producing operations near the floor of the building, such as spent gases from heat-treating furnaces or smoke from forging operations, tend to rise toward the roof with the warm air currents. Thus, the first step in eliminating fumes is to permit them to escape through an opening in the roof at the peak (Fig. 2b).

Venting the fumes in this manner solves one problem, but adds another. The air passing out through the roof ventilator must be replaced. During the summer, this is not too serious a problem if the building is exposed on at least two sides so that adequate outside air may be drawn in to replace the exhausted fumes. In the winter, however, this replacement air must be introduced at a temperature at least as high as that of the normal building air to prevent chilling. Furthermore, it is necessary that when this is done, the make-up air should not interfere with the natural flow of fumes to the roof ventilators. Otherwise the efficiency of the operation will be lowered, due to failure to exhaust the highest possible concentration of impurities.

Effect of make-up introduction

If, for example, make-up air is permitted to leak in through the loose building construction and if steam pipe coils or gravity radiators are located around the exterior of the building to maintain temperature, air currents counter to the normal gravity flow of Fig. 2a will be set up and thereby reduce the pull of the ventilator on the interior area of the building. This is shown in Fig. 2c, which indicates the air currents from wall radiation rising along the sidewall rather than up through the center of the building, thereby creating a stagnant condition in the interior of the building. Fumes and foul air originating in the middle of the building are circulated throughout the floor area instead of rising directly to the roof vents.

Similarly, forced circulation of air from suspended unit heaters, as shown in Fig. 2d, interferes with the flow of fumes to the roof. It tends to cause a more thorough mixing of the air and fumes in the building, so that the roof vent handles only a diluted sample of the undesirable fumes, while the entire building area is subjected to the mixed gases.

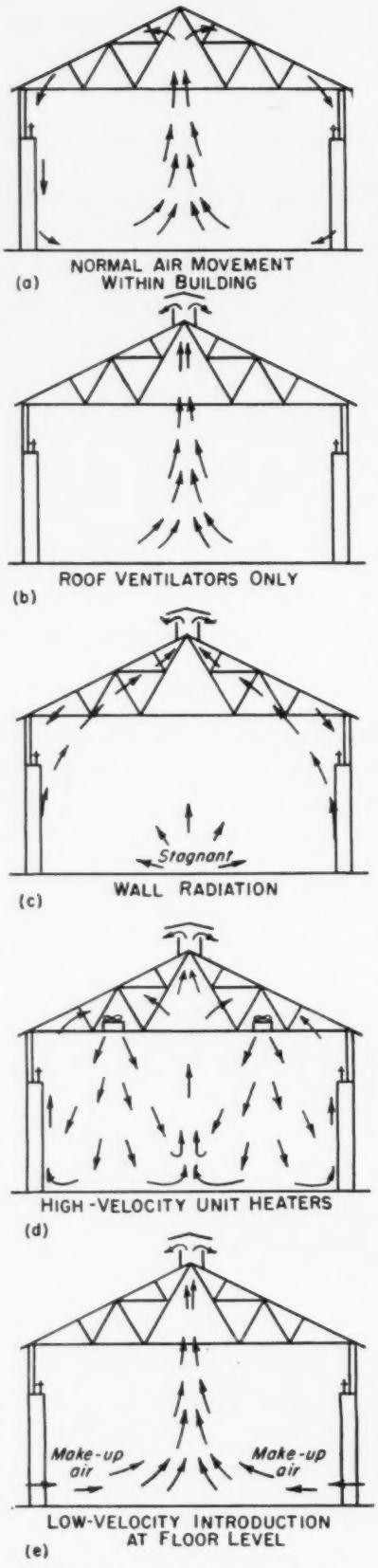

Fig. 2. Paths of air currents in a mill building are indicated by arrows.

From the standpoint of fume removal, any method of ventilation that depends upon high velocities for distribution is undesirable in that the high velocities tend to break up the natural flow of fumes to the roof ventilator.

The most desirable arrangement involves the introduction of make-up air at or near the floor level at low velocities, as indicated in Fig. 2e. Introduction of the replacement air in this manner tends to aid the natural air circulation in the building so that the fumes rise directly to the roof ventilator. Furthermore, this method of distribution provides maximum purity of air at or near the floor line in the occupied zone. The entire floor area is flooded with a low-velocity stream of fresh air so as to give the occupants full advantage of ventilation.

Unit for high-pressure steam

The type of apparatus used to provide heated make-up air varies with local conditions. Briefly, two general types are available—indirect-heated equipment, using steam or hot water, and direct-fired equipment, in which the fuel (generally gas or fuel oil) is burned within the heating apparatus.

For large ventilating systems in steel mills and similar heavy-industry buildings, steam at high pressure is sometimes used because of the comparatively small line sizes required, but provision of a heating surface capable of withstanding the pressure and temperature is a major problem. For example, the light-weight copper heating surface developed for low-pressure steam-heating work is limited generally to a maximum of 200 psi. gage pressure and 100 deg. F. total temperature. However, the recent development of a heavy-walled finned steel heating surface (Fig. 3) capable of withstanding full-line steam pressures has solved this problem.

The heating coils are constructed of

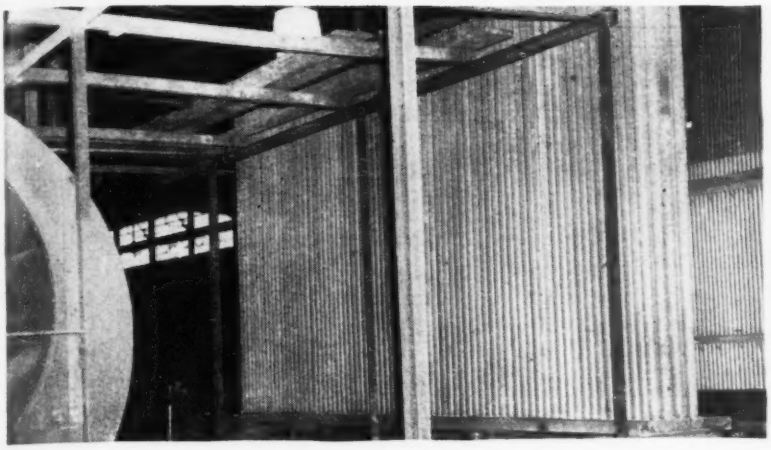

Fig. 3. High-pressure steam heater composed of coils of 1¼-in. steel pipe wound with an external finned surface was designed to raise the temperature of 200,000 cfm. of air 120 degs. F.

Fig. 5. Central space heater exhausts all the noxious products of combustion outside the building.

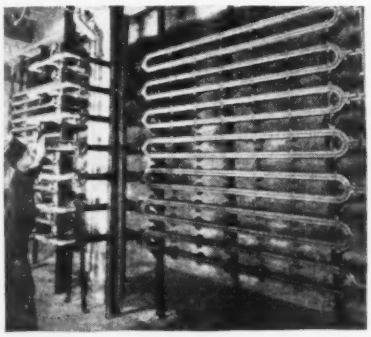

Fig. 4. Direct-fired heater burns natural gas directly in air stream, eliminating heat-transfer surface.

standard 1¼-in. dia. steel pipe, wound with an external finned surface to increase heat-transfer capacity. The finned pipe is galvanized to insure a permanent bond between fin and pipe and to avoid corrosion externally and internally. Individual finned pipes are fabricated into banks of coils of 18 pipes each, welded into fabricated steel headers at each end.

The coils are arranged in multiple in width and depth, as required for temperature and volume of air to be handled. Each coil has an individual steam supply from a common header, and individual traps drain the condensate from each coil into a single header. The piping is inclosed in a sheet metal housing to guide the air through the coils.

For plants that do not have excess steam for heating, several types of direct-fired apparatus are available. In Fig. 4 is shown a unit in which gas is burned directly in the air stream at high efficiency. The continuous exhaust of the mill space makes this method practical, since there is no opportunity for any serious concentration of the products of combustion in the occupied space. Central space heaters, as shown in Fig. 5, that do not introduce the products of combustion into the occupied space, are used where complete exhaust is not necessary or the products of combustion from the fuel would be obnoxious.

Ducts distribute make-up

In general, to achieve the low-velocity discharge of air at floor level, as indicated in Fig. 2e, it is necessary to provide a sheet-metal duct distribution system to carry the replacement air from a central heating station to the multitude of necessary outlets. A typical distribution system is shown in Fig. 1. Main ducts are run above the bottom chord of the building trusses so as to avoid interference with the crane. Sheet metal "downcomers" are installed at each column, with a flared 45 deg. angle down-outlet at the bottom of each located about 4 ft. above floor level. This duct distribution system accomplishes the effect of flooding the occupied zone with fresh tempered air.

In buildings housing a series of annealing furnaces at one end, concentration of roof ventilators above the area in which the furnaces are located permits venting of fumes directly to the outside, and a general movement of air toward the furnaces is developed within the buildings. Thus, any tendency to spread the fumes is eliminated by the slow drift of uncontaminated air toward the point of contamination and then outdoors. Other fume- or vapor-producing apparatus that may in the future be necessary within such buildings can be treated in a similar fashion.

Rate of air change estimated

In buildings housing only moderately severe fume-producing apparatus, it has been found satisfactory to change the building air completely three times per hour when supplying the ventilation in the manner shown in Fig. 2e. Severe fume conditions will require complete air changes of 10 to 15 per hour even with local hood exhaust. If the exhaust is balanced with replacement air without causing high cross-currents, it is possible to reduce the exhaust required, thereby simplifying the ventilation problem.

The requirements of a good fume-removal and ventilation system may be summarized as follows: (1) For maximum efficiency of exhaust, air removed should contain a maximum concentration of impurities. (2) Exhausted air should be replaced by a minimum of fresh air, tempered at the lowest possible cost. (3) The replacement air should be distributed over the entire floor by a multiplicity of outlets at low velocities to avoid drafts and short-circuiting to roof ventilators. (4) The utmost in simplicity and ruggedness, using a minimum of tempering equipment, should be the aim in layout and equipment.

Fig. 1. Big hauling units are being used to speed the movement of sand and gravel into the new Baltimore airport.

50,000 cu.yd. Daily for Baltimore Airport

Contents in Brief: *Upward of 50,000 cu.yd. of sand and gravel is being moved and compacted daily to complete grading of three runways of a new airport for Baltimore during this working season. Sand and gravel, so clean and non-cohesive that even large tires sink deeply into it, is compacted by exceptionally heavy sheepsfoot rollers and will be finished by a 200-ton super-compactor unit. The clean sand and gravel, available all over the site, is utilized for soil-cement to support large concrete drainpipe. Of unusual interest is a table giving quantities moved by each of six types of hauling units.*

BIDDERS on the Baltimore, Md., Friendship Airport last spring wondered about being able to haul and compact some 6,000,000 cu.yd. of sand and gravel during this working season, but the one who got the contract, after some experiments with loading, hauling and compacting machines, soon reached a steady pace of moving some 50,000 cu.yd. of material per day. Compaction is in the 95-105 range by the modified Proctor tests. But, tests are made at a 2-ft. depth as sheepsfoot rollers will not compact the surface.

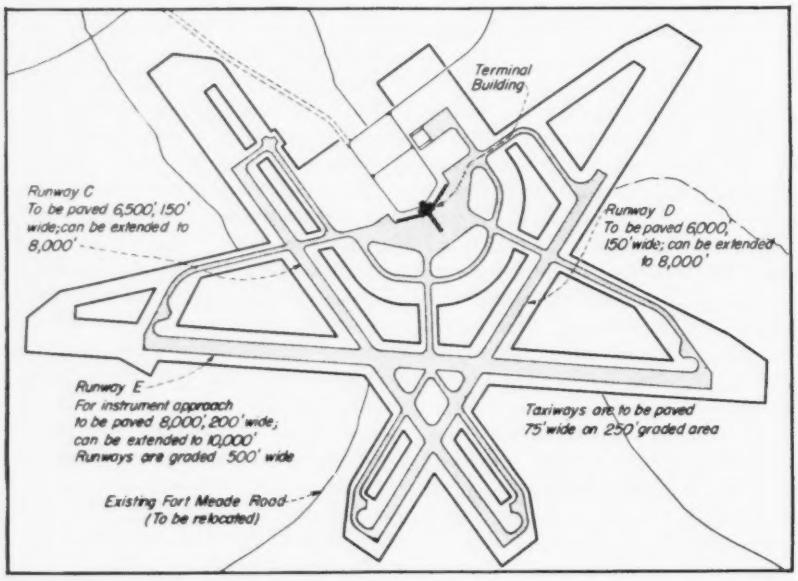
Terminal Building
Runway C
To be paved 6,500', 150' wide; can be extended to 8,000'
Runway D
To be paved 6,000', 150' wide; can be extended to 8,000'
Runway E
For instrument approach to be paved 8,000', 200' wide; can be extended to 10,000'
Runways are graded 500' wide
Taxiways are to be paved 75' wide on 250' graded area
Existing Fort Meade Road
(To be relocated)

Fig. 2. Baltimore's airport has three runways 8,000 to 10,000 ft. long, but full length will not be paved at this time.

A 200-ton super-compactor on large pneumatic tires has been ordered for use at the surface, with the expectation that it will solidify the material sufficiently so that a comparatively thin pavement can be used. Also, it is expected that it will compact undisturbed material in cut areas so that excavation and replacement will not be necessary. Savings in earth moving, compaction costs and use of a less expensive paving through utilization of the super-compactor are estimated to amount to $1,500,000.

The airport is expected to cost some $13,000,000, including an adequate terminal building with loading space for ten planes. Plans include details for expansion of the terminal structure and the port capacity as conditions warrant.

The site selected includes 3,000 acres of rolling land 9 miles south and a little west of the city. All runways areas are being graded for a width of 500 ft. and taxiways for 250 ft. width. Runway C is 8,000 ft. long and will be paved next season for a length of 6,500 ft. and a width of 150 ft. Runway D is 8,000 ft. long and will be paved 6,000 x 150 ft. Runway E, for instrument approach is 10,000 ft. long and will be paved 8,000 x 200 ft. Only narrow shoulders, about 10 ft. out to the runway lights,

Fig. 3. Pull tractors with cable-controlled connection devices were found to work best for loading some carrying scrapers.

will be provided, but high surface compaction will be sought for a width of 75 ft. on each side of the runways.

Maximum cuts on the airport are about 30 ft. and fills range up to 27 ft. over old stream courses. Most of the material to be moved is a relatively clean sand and gravel that is noncohesive and ruts deeply under even the largest tires. Crawler treads stay on top of the sand and gravel but wear rapidly from abrasion.

Construction is done on two 10-hr. shifts with a large and efficiently operated fleet of earth moving equipment. An accompanying table shows the machines in use to move upward of 50,000 cu.yd. per day and the approximate production of each type of unit. It should be noted in studying the table that production figures are for different lengths of haul and that materials moved on different parts of the 3,000-acre airport are substantially different.

For the shortest hauls, tractor-drawn 15-cu.yd. carrying scrapers are used. Four-wheel tractors drawing 7 cu.yd. carrying scrapers are used for intermediate hauling distances. These units frequently are used in stripping topsoil, which it is desirable to conserve for later use on shoulders, or sand and gravel that will compact especially well for use on the runway areas immediately under the pavement. Both types are loaded with the assistance of a push tractor.

Two-wheel tractors and large carrying scrapers work very satisfactorily for long hauls and are loaded with a pull from a crawler tractor. The wheel tractors sometimes have difficulty hauling loads over loose sand and gravel but in general need only a push for a very few feet to get out of a low spot to resume speed.

Wagons for long hauls

For the longest hauls, shovels are used to load 13-cu.yd. bottom-dump tractor-drawn wagons. The two shovels in use are each 2 cu.yd. but have had the buckets built up, by additions at the back and sides, to a capacity of 2.7 cu.yd. The shovels load the 13-cu.yd. wagon in 5 buckets of material in 1½ minutes. A plow and belt type loader was tried in the sand and gravel soil and worked quite satisfactorily but the hauling units could not pull away from the machine with a load. It was found that the wagons worked better loaded by a shovel, where a haul road could be maintained.

Compaction of the non-cohesive sand and gravel is no less difficult than hauling through it. Material is spread in 8-in. lifts by the hauling units or by bulldozers and is compacted by heavy sheepsfoot rollers. But in this material the surface stays loose under operation of the sheepsfoot unit.

It is not believed that the hauling equipment accomplishes much in the way of compaction. It passes over the sand and gravel so rapidly that entrapped air does not have an opportunity to escape. Even over sheepsfoot-compacted material, when speed is slow enough that the air does escape, the hauling units bog down.

Despite this condition, good compaction is being attained by only four passes of the sheepsfoot roller for 8-in. lifts, as is proved by test results of 95-105 percent compaction attained on the modified Proctor basis. Tests are made at a depth of 2 ft. as it is at this depth that full effect of compaction method is reached.

Rolling is done with especially heavy sheepsfoot units that can be loaded to as much as 685 psi. though the rollers are now operated at about 530 psi., compared to a maximum of 269 psi. for most rollers. Two 7-ft. dia. drums are used to secure 14-ft. 4-in. effective path widths with a third drum trailing at the center. Drums are 60 in. dia. and have 8-in.

Table I—Equipment used to move 50,000 cu.yd. of sand and gravel per day

Equipment	Rated capacity cu. yd.	Moved by	Average units working	Average load cu. yd	Usual haul ft.	Average per unit per hr.
Carrying Scrapers.....	15	107 h.p. Track tractors	9	10	500	110
Carrying Scrapers.....	7	75 h.p. 4-wheel tractor	5	7	1000	80
Carrying Scrapers.....	15	150 h.p. 2-wheel tractor	12	10	2000	90
Carrying Scrapers.....	18	150 h.p. 2-wheel tractor	1	13	2000	105
Carrying Scrapers.....	23	225 h.p. 2-wheel tractor	1	18	2000	110
Bottom dump wagons....	13	4-wheel tractor	11	12	3000	55
Shovels.....	2	.....	2	2.7	....	350

Table II—Supplemental Equipment on Baltimore Airport

	Moved by	Average working
Sheepsfoot rollers.	100 h.p. track tractors	3
Bulldozers.....	107 h.p. track tractors	19
Bulldozers.....	125 h.p. 4-wheel tractor	1
Patrol blades.....		3
Lighting Units...	Truck mounted	3
Lubrication Units	Truck mounted	2
Fuel trucks.....	Truck mounted	1

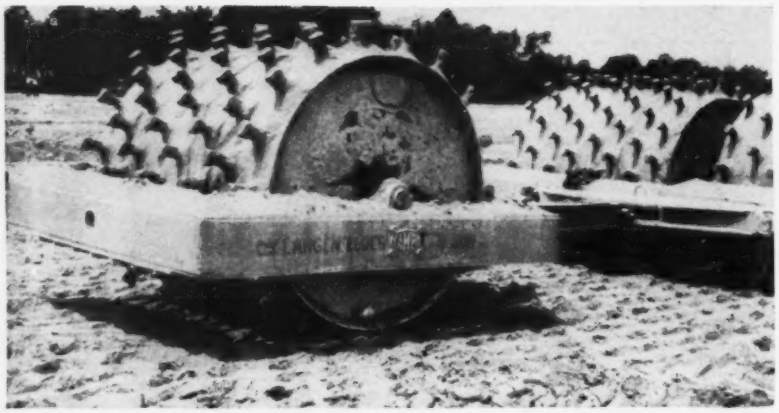

Fig. 4. Sheepsfoot rollers with a weight of 685 psi. of contact area compact the sand and gravel of the airport runways to a 95-105 ratio on the modified Proctor basis.

Fig. 5. Shovel, with 2 cu. yd. dipper built up to 2.7 cu yd., loads 13 cu. yd. wagon in 5 swings.

Fig. 6. Sprinkling bars are placed ahead of wheels so that 3,000-gal. tank truck can get through dry sand and gravel. Water is forced from tank by 3-in. pump in a volume that permits 25-mph. travel. Sprinkler bar in front of rear wheels has gravity flow.

long feet so that overall diameter is 76 in. The feet each have an area of 6.25 sq.in. and eight on each of the three drums are in contact with the ground at all times.

Specifications state that if additional compaction or other manipulation of the soil is required it will be paid for. For example if more than the four passes of the roller are required, the contractor receives $8.50 per hour for supplying and operating the roller and tractor. This provision of the specifications is believed to have been an important factor in securing favorable bids. A letter from a prominent contractor, printed on the next page, indicates the bidders attitude toward such provisions.

Eight of the eleven bids were under the engineer's estimate, the lowest by 28 percent. Low bid on the unclassified excavation was 25 cents per cubic yard compared to 35 cents in the engineer's estimate. Compaction was bid at 1.8 cents per cubic yard compared to 5 cents for the engineer's estimate. Other unit prices are given in *ENR*, June 26, 1947, vol. p. 1,035.

Surface compaction

The surface of the runways, which it is hoped will be adequate for the pavement base, will be finally solidified by a "super-compactor" unit that can be loaded to give a weight of 40 to 200 tons on four 30 x 33-in. tires. The super-compactor is in two articulated units or load boxes arranged to be about 16 ft. c. to c. Each unit is 20 ft. long, 88 in. wide and is supported by two wheels on a single axle. Tires are 60 ply to work at pressures of 125 to 150 psi. The equipment is similar to that developed by O. J. Porter and the Corps of Engineers, *ENR*, Mar. 21, 1946, vol. p. 422.

This super-compactor unit, to be delivered in October, will be drawn by a crawler tractor at a speed of about 1½ mph. as it has been found that speeds in excess of that do not allow sufficient time for entrapped air to escape.

It is specified that the 200-ton compactor unit shall be so arranged and equipped that it can be used to make bearing tests in the field. It will be operated by the Department of Aviation of the city of Baltimore, using a rented track-type tractor.

It is anticipated that after the unit has served its purpose in compacting the surface of the airport, it may be used to work and "keep alive" flexible type pavement, particularly along the edges of the runways and at other points where non-use results in rapid deterioration of black-top surfaces.

Most of the soil on the airport is clean sand and gravel but there is with it some thin lenses and pockets of impervious silty clay. This clay holds water and thus is subject to frost action, which is undesirable anywhere near the surface of material that is expected to carry flexible pavement without a base. The clay is better soil than is available for some airports, but at this location more desirable material is available at only the cost of moving.

When clay is encountered in handling operations it is used in the fill outside the area to be paved where, in small quantities, it is not expected to be harmful. Where clay is in the runway areas below the established grades, it is dug out and disposed of elsewhere.

While the relatively clean sand and gravel of the airport caused difficulties in hauling, it served at the same time as an excellent aggregate for soil cement used to support concrete pipe drains. The 200-ton compactor unit and heavy planes of the future will make a very heavy concentrated load on the pipe in shallow fill areas. Heavily reinforced pipe is being used but there is an economic limit to strengthening it. Plans called for concrete encasement or concrete cradles for much of the pipe under runways.

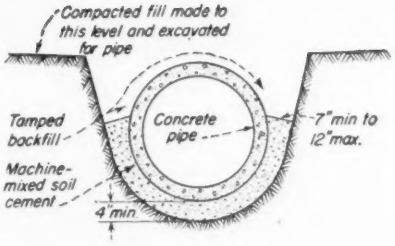
Compacted fill made to this level and excavated for pipe
Tamped backfill
Concrete pipe
7" min to 12" max.
Machine-mixed soil cement
4" min

Fig. 7. Soil-cement, mixed from sand and gravel at point of use, makes low-cost encasement for drainage pipes.

In some areas only a small amount of stiffening of the pipe line was required. Here it was practical to support the pipe by filling under it and along its sides with soil-cement. The soil-cement could be made very economically with three bags of cement per cubic yard using "bank-run" sand and gravel picked up on the airport near point of use.

A paver was used to mix the soil-cement and to deposit it along the pipe line as required. Aggregates were proportioned by clamshell bucket filling of a three-compartment batch truck to a marked level; cement was added at the skip in bags. In areas where the sand and gravel was so non-cohesive that hauling was especially difficult, the material was excellent for aggregate. The crane followed the paver, placing aggregate directly into the skip in measured clamshell bucketfuls.

The trench for the pipe, Fig. 7, was made only enough larger than the pipe that a small man could get at the joints. The soil-cement was mixed rather dry except for enough to flow under the pipe at the start of placing. Soil-cement was used to fill the entire trench to above the center of the pipe and was packed into place with a pneumatic tamper.

The soil-cement cost only about one-fourth as much per foot of pipe as conventional concrete encasement. Where the latter was used, the trench was made larger and the sides formed. Building forms, stripping and backfilling involved considerable expense not required with soil-cement.

The development of the Baltimore Friendship Airport work is being carried on by the Department of Aviation of the City of Baltimore, which is headed by the Airport Board. The work is under the supervision of Cecil R. Moore, director of the Department of Aviation. C. F. Grigg is the field representative of the Aviation Department. Engineering is being done by Whitman, Requardt Greiner Company and Associates, a combination formed for this job by two of Baltimore's leading engineering firms. For this organization B. Everett Beavin is engineer in charge of the project and Graham R. Hevell is resident engineer.

The $2,064,000 contract held by C. J. Langenfelder & Son, Inc., of Baltimore, is under the general supervision of J. P. McInnis, chief engineer and E. F. Purcell general superintendent. The drainage work has been sublet to M. J. Bles Construction Co., McLean, Va.

A Letter to Whitman, Requardt-Greiner Co. and Associates

Your specification for the construction of the grading and drainage of the Baltimore airport, to my mind, is an outstanding example of the results that can be obtained by eliminating, wherever possible, contingencies to be assumed by the contractor and thus to obtain the lowest bid prices.

One of the most difficult problems to estimate in the construction of roads and airports is the cost of compaction to meet some theoretical test. As you know, some specifications state that the subgrades shall be compacted to 95 percent maximum density, according to the AASHO modified Proctor test. The application of this test in field conditions is difficult, and often not very accurate, with the result that the contractor's operations are greatly delayed awaiting the results of these tests.

When you specified the method which the contractor should use, and then stated that additional rolling, if ordered, would be paid for, you removed this contingency from the contractor's shoulders, and at the same time kept within your power the facilities necessary to obtain whatever additional compaction conditions in the field might warrant.

I know from conversations with a number of the contractors that this provision in the specification was one of the items that persuaded the contractors to give you the lowest possible prices, and further assured contractors that you were cognizant of the practical problems involved in performing this type of work.

I sincerely hope this object lesson will be considered by other engineers in writing specifications that impose undetermined and unseen risks on the contractor which, in fairness to all parties, should be left open for adjustment to meet field conditions.

OSCAR B. COBLENTZ, *President*
McLean Contracting Co., Baltimore, Md.

Mr. Coblentz, a past president of the Associated General Contractors of America, has for many years been a leader in promoting equitable and more economical specifications.—EDITOR

San Francisco Examines Sewer in Place

Ralph G. Wadsworth
City Engineer
City and County of San Francisco

***Contents in Brief**—To find a rational basis for scheduling replacement of sewers, 50 to 70 yr. old, $19,300 was spent by San Francisco on the inspection of a line before it was disturbed. This investigation, coupled with other related information, enabled city officials to adopt a tentative policy for sewer reconstruction.*

LAST YEAR San Francisco, in the course of replacing ten blocks of old pipe sewer, spent an extra $19,300 to ascertain the condition of old pipe before it was disturbed. Reliable information as to what happens to sewer pipes during 50 to 70 yr. of service was needed to serve as a basis for determining when and under what conditions sewer replacements are justified. The investigation disclosed, as expected, that the older sewers were in the worst condition, but that defects noted were due to faulty workmanship and materials rather than age. There was no evidence of chemical action and little indication of erosion inside the pipes. Furthermore, in spite of extensive cracking of the thin-walled clay pipe used in early days, no actual collapse had occurred.

As a result of the investigation and the conclusions drawn from it, the San Francisco Department of Public Works has adopted tentatively the policy that an existing pipe sewer will be replaced only when one of the following conditions obtains: (a) The capacity is deficient, (b) settlement or collapse prevents satisfactory service, (c) the annual cost of repairs in any block approaches the annual interest charge on the probable cost of replacement, or (d) tangible evidence is present that defects exist which are likely to cause collapse of the overlying street pavement or other damage.

More intensive efforts will be devoted to the discovery of dangerous defects in sewers by inspection at manholes and by periodic examination of overlying pavements. Special attention will be given to sewers where extensive repairs have been found necessary in the past, where the pipe is over 65 yr. old, and where the surrounding soil is known to be sand.

Replacement policy needed

The need for a definite policy in the matter of sewer replacements had been apparent for a long time. In recent years the city proceeded on the assumption that, whenever a major street reconstruction is undertaken, the underlying pipe sewers, if old and not known to be in sound condition, should be replaced with new pipe so as to avoid possible later disturbance of the modern pavements. It was also believed that if numerous repairs had been made in any section of sewer, the whole section was probably defective and should be replaced. On this basis numerous sewers throughout the city were scheduled for replacement as a result of analysis of records of repair jobs performed during the past 9 yr., during which time careful records were maintained. However, few actual replacements have been made because funds were seldom available to care for anything but necessary extensions and enlargements.

San Francisco's early sewer system, until about the turn of the century, was built with inadequate engineering control and inspection. Several different types of pipe were used and foundations included solid rock, loose sand, and clay. Many sewers are laid on grades exceeding 20 percent, while others are in flat, filled ground which is continuously subsiding.

Under such conditions sewer failures have been frequent. In many instances, damage to sewer and street has been caused by a flow of water into the sewer through open joints which carries with it sandy soil. Thus, the street pavement becomes undermined and a general collapse results.

At the present time between 400 and 450 sewer repair jobs are performed each year at a cost of about $140,000. In some cases of pavement collapse, heavy claims for damages have been filed against the city. Since the city's liability is dependent in part on the degree of vigilance exercised in discovering and repairing breaks or in replacing defective sewers before pavement collapse can occur, it is obvious that a definite policy regarding sewer maintenance and replacement is essential.

When a sewer break is repaired, it is usually difficult to determine just what caused the trouble. Working under adverse conditions of weather and water flow, repair crews can give little time or attention to examination of the pipe being removed. Even when an old sewer is being replaced under the most favorable conditions, use of power-driven excavating equipment ordinarily precludes any examination of the old pipe in its undisturbed condition.

Special replacement contract

To overcome this difficulty, it was decided to undertake replacement of a typical stretch of old sewer under special contract provisions which would permit a thorough inspection of the pipe prior to removal. Nine blocks of sewer and a one-block lateral were selected for the purpose. According to the somewhat unreliable records for the period preceding the 1906 fire, the job included both concrete and vitrified clay pipe. In six of the blocks the sewer was supposed to be over 68 yr. old; in another three blocks it was over 57 yr. old; and in the remaining block, 37 yr. old. Pipe

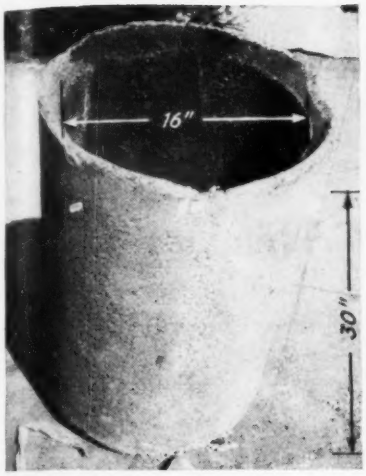

Fig. 1. This concrete sewer pipe was removed in relatively good condition after 70 yr. of service.

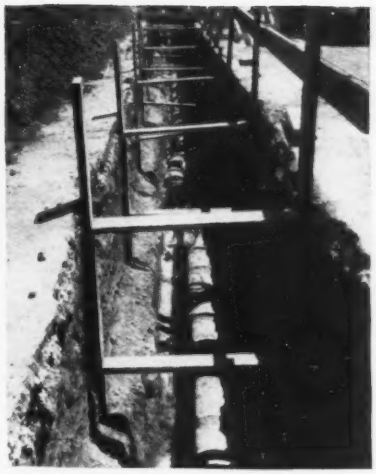

Fig. 2. The last 12 in. of excavation was performed carefully by hand. Pipe in background collapsed when exposed.

diameters varied from 12 in. to 18 in. and grades from 1.2 to 10.1 percent.

The contract provided for complete replacement of the old sewer including the installation of Y branches at all side sewer connections. Special provisions required the contractor to conduct excavation operations so as not to disturb or damage the existing pipe prior to its examination by the engineering inspector. All excavation below a plane 1 ft. above the top of the pipe bells was required to be done with hand tools. A trench width greater than normal was specified to permit inspection of three-quarters of the outside circumference of the pipe before removal. This required a minimum clearance of 12 in. between the bells and the trench lagging.

The contract also required the contractor, when directed, to remove from the trench intact such sections of the sewer as might be designated. These sections were not greater than one complete pipe length plus not less than 6 in. of the barrel of the adjacent upstream pipe length in addition to the bell and not less than 6 in. of the barrel of the adjacent downstream pipe length. Great care was required in this work to make sure that the two joints were kept in their original condition.

Unit price bids were required in accordance with normal procedure for the installation of the new pipe and Y branches and the construction of manholes. In addition, separate unit prices were called to cover the removal of pipe specimens for inspection and the extra work involved in providing for examination of the pipe in place. In the latter case, it was stated that the unit price bid would cover the added expense of the additional width of trench and the required hand excavation over and around it. The city was permitted to dispense with the examination of the pipe and the removal of specimens at any time, in which case only the normal unit prices for pipe replacement would apply. The cost of sewer replacement was set at $18.60 per ft. and the additional cost for examination of the old pipe was $4 per ft.

Examination of the pipe

A special engineering inspector was assigned to the job with the sole duty of supervising the uncovering of existing sewer and the examination of the exposed pipe. All breaks, cracks, open joints or other defects were noted and their location determined with relation to surface indications, such as depressions in the street pavement, or evidence of previous street repair work. Special attention was given to observing the condition of joints prior to disturbance of the pipe. The pipe sections lifted to the street surface were used to ascertain the condition of the pipe and joints at the bottom quarter of the pipe circumference, to determine the strength of the joints themselves, and to permit careful measurements of pipe diameters and thicknesses.

It was found that two blocks of sewer, presumed to be concrete pipe, had been replaced with vitrified clay pipe at some unknown date in the past. There remained in place, however, one block of 16-in. concrete pipe. The pipe sections were 30 in. long and the walls varied in thickness from $1\frac{3}{4}$ to 2 in. The quality would be considered very poor under present standards and the tongue and groove joints were poorly made.

The vitrified clay pipe laid in 1876 and earlier had unit lengths of only 24 in., although some 3-ft. lengths were also used. Wall thickness varied from 1 to $1\frac{1}{2}$ in. Bells were considerably shorter than present standards.

Almost all of the pipe joints were poorly made and found to be open at the invert. In one block all joints were completely open for the full circumference. At the open and partly filled joints there was little evidence that any mortar had been used, although it is possible that it could have been destroyed during the many years of service. Where the sewer was constructed in sand, there were many evidences of sand being carried into the sewer through the open joints. Extensive cavities under the street pavement were noted in two blocks.

Longitudinal cracks were frequently found in both clay and concrete pipe, particularly at the spring line on each side but, in some cases, at the crown as well. In one block fully 60 percent of the pipe lengths showed extensive cracking. Nevertheless, all of the pipe held together and no collapse occurred until all backfilling was removed. Where the pipe had been laid on a rock sub-grade, the cracking appeared to be the result of lack of sand cushion on the rock and insufficient side tamping.

Slight erosion of the invert of the pipe was noted in three blocks, but was principally confined to a single block having a 9.7 percent grade. The erosion, however, was apparently due rather to faulty jointing than to general wear since the principal effect was immediately at the downstream side of the joints. The single block of cement pipe laid on a 5.5 percent grade showed somewhat more erosion than vitrified clay pipes.

Cavities noted in sandy soil

Depressions in the street pavement or cavities under the pavement were generally confined to areas where the sewer was laid in sandy soil. Most

of the cavities were small, although two were found to have a surface area of about 24 sq.ft. Many of the cavities had existed unchanged for a good many years, as evidenced by the existence of rat holes in the walls. Of twelve cavities noted, four were caused by faulty joints between the main sewer and the side sewers, and the balance were due to either cracks or bad joints in the main sewer. Only three of the cavities had resulted in settlement of the overlying pavement.

Analysis of the results of the examination showed that the oldest sewers contained more cracked pipes and more repair jobs than the others. It was also demonstrated that those blocks in which the greatest number of repairs had been made also contained the greatest number of remaining defects. This would seem to indicate that age could be used as the criterion for determining the worst sewers and that this determination could be confirmed by noting the number of repair jobs performed. Such determinations would, however, necessarily be modified by consideration of the types of sub-grade in which the sewers were constructed.

It was concluded that depressions in the pavement, or other surface indications could not be relied upon to fix the location of all underlying cavities or defective sewer joints.

A possible general conclusion of the investigation might seem to be that all of the old sewers in San Francisco are in poor condition. Nevertheless, it was clearly demonstrated that the oldest sewers can function satisfactorily for an indefinite period even though defective in many particulars. Wholesale replacement of all old sewers is obviously out of the question from an economic standpoint and there appears to be no certain method of selecting those which are in such bad condition that failure of pipe or pavement is imminent. Consequently, the city has no alternative but to continue the present practice of repairing breaks as they occur and taking every precaution to insure the early discovery of breaks or serious leaks requiring attention.

Felling a Chimney with Dynamite

A concrete chimney at the old garbage incinerator in Spokane, Wash. outlived its usefulness and had to be removed to make way for a new chimney able to withstand higher flue temperatures expected in a new plant. The removal could be affected with least expense by felling the old chimney with a dynamite charge, but this required care to avoid damage to nearby property. By dint of accurate planning, the chimney was laid down exactly on the line marked out in advance. Details as to powder charges and locations are given below.

As originally built the chimney had a height of 202 ft.; some years ago a reinforcing wall was placed around the base 18 in. thick and extending up to a height of 32 ft. The charges for felling the stack were placed above this 32-ft. thickened base and hence the portion of the stack actually blasted down was only 170 ft. high.

Fig. 1. The Chimney held together during the fall but impact with the ground broke it into small pieces.

The outside diameter of the stack at the point where the charges were placed was 12 ft. 9 in. The chimney consisted of a brick lining, a 4-in. air space, and an outer reinforced concrete wall 9 in. thick, as shown in the sketch. Reinforcing in the concrete at the point where the charges were placed consisted of ¾-in. vertical bars on 8-in. centers and ⅝-in. horizontal bars on approximately 12-in. centers.

In preparation for the blast four openings were cut through concrete shell and brick lining, leaving four columns supporting the structure. The columns, as shown in the sketch, are numbered in the order in which the charges were fired.

For the entire job 25 lb. of 50 percent ditching dynamite was used. Column No. 1 was loaded with 7½ lb.; the side columns (2) were loaded with 7½ lb. each, and column No. 3 was loaded with 3½ lb. Holes were drilled in each column so that the powder could be distributed at the rate of half a stick in each hole.

Electric detonaters were used and by means of delayed action caps on charges No. 2, these exploded about one second after the charge in column No. 1. When the two side columns were blasted away the stack began to fall exactly in the direction planned. After it had reached an angle of about 20 deg. charge No. 3 was fired by instantaneous electric caps.

The result was entirely satisfactory, the chimney falling exactly along the line desired. Moving pictures of the fall showed that the stack fell, apparently, as a single integral unit and did not break up until it struck the ground.

Harlan Coe is superintendent, crematory division, Spokane, Wash.

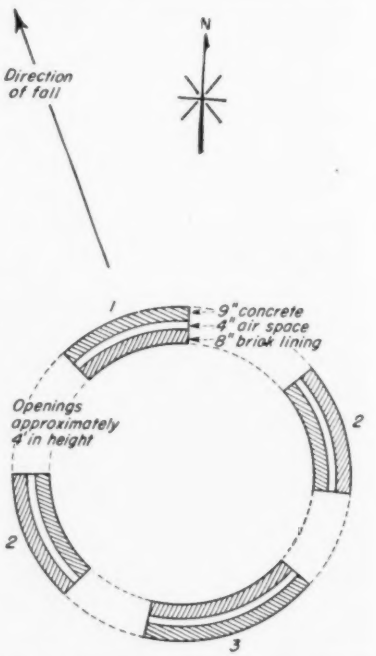

Fig. 2. Diagram showing location of cuts and charges at the base of the 170-ft. portion.

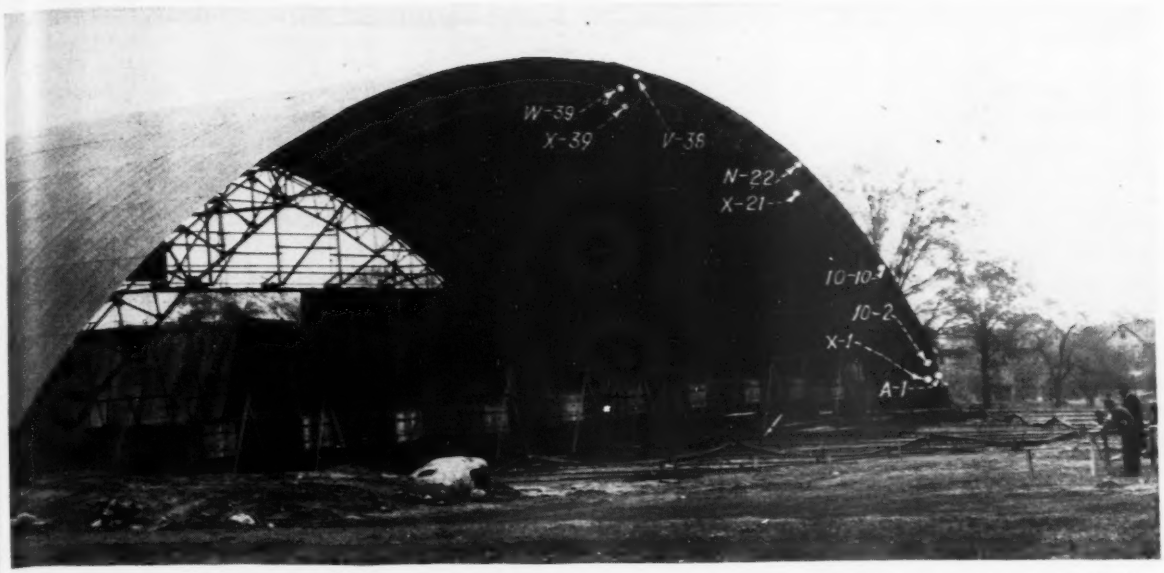

Fig. 1. Arched-truss hangar, spanning 194 ft. with a rise of about 45 ft., was loaded to failure using water tanks.

Steel-Arch Hangar Tested to Destruction

Harold E. Wessman
Professor of Structural Engineering and Chairman, Dept. of Civil Engineering
New York University, New York, N. Y.

***Contents in Brief**—Designed for military use under emergency specifications, a portable steel hangar was tested to destruction with 84 gages attached to the main structural members to register the strains under each increment of load. The three-hinged, steel arched-truss, spanning 194 ft. with a rise of about 45 ft., failed under a load equal to dead load plus about 175 percent live load. A bottom chord member at the crown buckled due to bending in two planes caused by the hinge connection.*

"How MUCH can the live load be increased on a structure that I have designed before failure actually occurs?"

Few engineers have had the opportunity to answer that question accurately, for, in ordinary times, the cost of building full-scale structures and testing them to destruction is prohibitive. But things are different in wartime. In several cases, the critical load had to be found for full-size buildings designed especially for war needs using emergency specifications.

One of the largest structures in this category was the bolted, steel arched-truss hangar designed by Peter A. Strobel, consulting engineer, New York City, for the Luria Steel and Trading Corp. to house the famous B-29 bomber. The main structural element of the hangar was a three-hinged steel arch with a span of about 194 ft. and a rise of about 45 ft. It was so designed that it could be shipped—disassembled and crated—to any theatre of operations, and there quickly erected with a minimum of mechanical power.

Water tanks used for loading

At the request of the Office of the Chief of Engineers, United States Army, an actual section of the hangar 90 ft. long, supported on six arches, was erected and a load test to destruction made on one of the intermediate arches. In Fig. 1 is shown the test section of the hangar on the grounds of the Empire Race Track in Yonkers, N. Y., with the 13 timber water tanks used for applying the test loads.

Each tank was placed on blocking and then attached to wire ropes slung from panel points of the first interior arch. Turnbuckles attached to the ropes permitted each tank to be raised from the blocking and suspended freely from the arch.

A separate water pipe connected each tank to a header main, which paralleled the arch about 100 ft. away from the structure. Separate valves in each tank pipe line and a flow meter on the main provided an excellent method for remote control of the water loads added to each tank, thus eliminating danger to personnel in the advanced stages of loading.

The roof framing consisted of parallel-chord trusses with springing and crown details designed to permit erection as a three-hinged arch. Under live load, the footing details developed some restraint, but not enough to warrant considering the arch as having fixed ends. Horizontal

thrust was resisted by steel tie rods under the hangar floor.

The bottom and top chords of the arched trusses, and those web members normal to the arch rib and located at the points where the arch segments changed direction, were composed of two angle members. All diagonals, however, were single angles. Joints were bolted.

Strains measured in several members

Electric gages were used to obtain strains in selected members in the various stages of loading, but during the initial stages, when the structure was obviously safe, a portable mechanical strain gage was also used for several members near the footings.

After the field loading tests were completed, specimens were cut from the steel angles comprising the truss members, and tests were made in the laboratories of New York University to determine the modulii of elasticity. These values were used for converting observed strains into stresses. Stress profiles were plotted for the test members to indicate the variation due to bending, and the average or direct stress in each member was then computed so that the empirically determined stresses could be compared with the theoretical.

The members to which electrical strain gages were attached are marked in Fig. 1 for convenience on the north half-arch next to the test arch. The same marks designate the members listed in Table II. Gages were also attached to corresponding members of the south half-arch, and in Table II, these members are marked with a prime symbol.

In each half-arch, three top and three bottom chords were selected for strain measurement—one at the footing, one at the quarter point, and one at the crown. In addition, strain gages were connected to both ends of the tie rod, one diagonal near the footing, one diagonal at the crown, and a vertical member at a connection point for a bracing strut between the quarter point and the footing. Thus, strain measurements were obtained for 18 of the truss members in the arch, as well as for each end of the horizontal tie rod.

Over four miles of wiring was required to bring the leads from all gages to a central control station (Fig. 2), about 100 ft. from the arch,

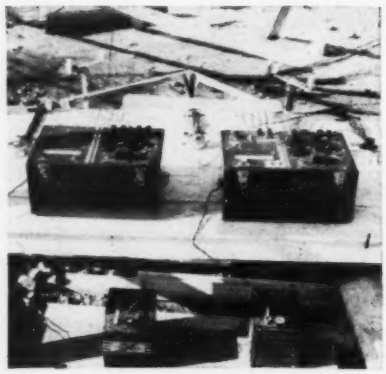

Fig. 2. Leads from electric strain gages were brought to a control station where switches and two Wheatstone-bridge control boxes were mounted.

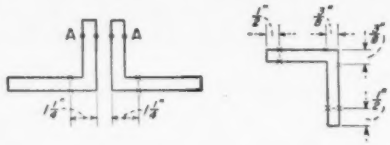

Fig. 3. Electric strain gages were located at points marked X. Additional gages at A were desirable but not used.

where multiple contact switches and two Wheatstone-bridge control boxes were mounted for measurement of the strains. The gages were SR-4 bonded metalectric strain gages, type A-1, manufactured by the Baldwin-Southwark Co.

To obtain stress profiles, several gages were attached to each member (points marked X in Fig. 3). Strains must be measured at several points and, in particular, on both sides of a thickness of metal if a correct value is to be assured for the average stress. A gage on one surface alone may lead to an extremely faulty interpretation of stress in the member as a whole.

Although four gages were attached to the double angles, it would have been desirable to have had an additional four at the points marked A. The sections were so close back to back, however, that it was impossible to attach gages on the surfaces between the angles. Under the circumstances, gages were placed near the root of each angle to obtain a fairly accurate value of the stress at the center of gravity. In the case of single angles, it was possible to place six gages on each member and obtain accurate stress profiles for each leg.

A total of 84 strain gages were used for the various members and the tie rod. Six additional gages of the same type were mounted on six steel bars placed near each group of test members for temperature compensation purposes.

Test results show definite trends

The loadings and the dates on which they were applied are shown in Table I, which supplies the key for the loading numbers used in the subsequent discussion of the results. In interpreting the tests, it should be kept in mind that the entire dead load was acting when the strain gages were attached. Hence, zero strain readings correspond to full dead load, and all subsequent strain readings are for the increments of live load.

Average stresses in the members for the loading conditions of April 19, when the arch was tested to destruction with the live load over the whole arch, are summarized in Table II. Values of E for converting the strains to these stresses for different members are listed in Table III.

The average stresses for test loads over the whole arch show rather consistent trends. For example, in gen-

TABLE I—LOADING CONDITIONS FOR HANGAR TEST

Loading No.	Description	Equivalent Load in Lb. per Horizontal Sq. Ft. of Roof	Date
1	Dead load	7.5	April 17, 1945
2	Dead plus center live load (from 5 empty load tanks)	—	April 17, 1945
3	Dead plus 60 percent live load on whole arch (all tanks empty)	19.5	April 17, 1945
4	Dead plus 75 percent live load on whole arch	22.5	April 17, 1945
5	Dead plus 100 percent live load on whole arch	27.5	April 17, 1945
6	Dead load	7.5	April 18, 1945
7	Dead plus 60 percent live load on half-arch	—	April 18, 1945
8	Dead plus 100 percent live load on half-arch	—	April 18, 1945
9	Dead plus 100 percent live load on whole arch	27.5	April 18, 1945
10	Dead plus 60 percent live load on whole arch	19.5	April 19, 1945
11	Dead plus 100 percent live load on whole arch	27.5	April 19, 1945
12	Dead plus 150 percent live load on whole arch	37.5	April 19, 1945
13	Dead plus 175 percent live load on whole arch	42.5	April 19, 1945

eral, the stresses for dead plus 100 percent live load are slightly greater than the theoretical.

One factor that will account for this is the presence of wind stress in the experimental results. On April 19, when these particular tests were made, the wind increased gradually throughout the day, becoming gusty during the afternoon. The variation in stress, particularly in the members at the crown, was clearly evident on the control box.

Also, some of the variation between experimental and theoretical results is due to the fact that the arch is not a true three-hinged arch. Restraint is developed at the supports because of the footing detail used.

Stress profiles for two bottom and two top chords are shown in Fig. 4 for the increment from load condition 10 to condition 12, the last complete full-load condition. This increment was equivalent to 18 lb. per horizontal sq. ft. of roof projection, and it brought the total load on the arch to 37.5 lb. per horizontal sq. ft. of roof—equivalent to dead plus 150 percent live load on the entire arch.

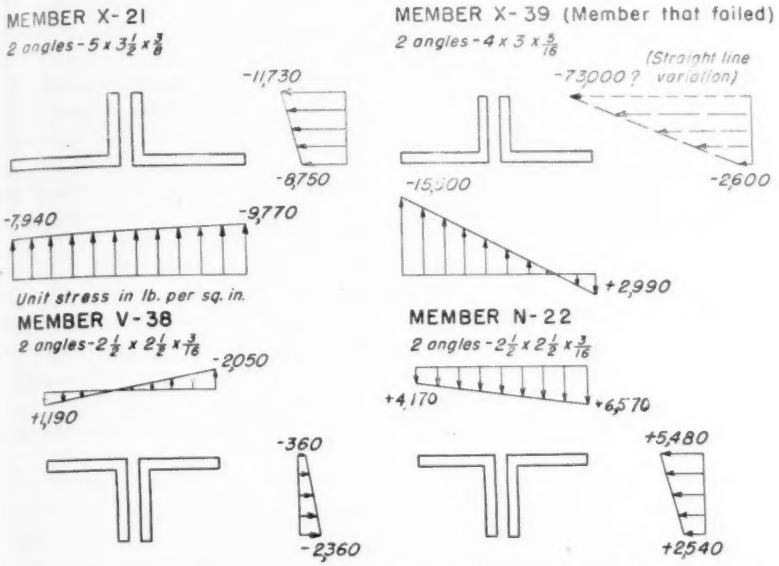

Fig. 4. Stress profiles for four members for load increment equivalent to 18 psf. of horizontal projection of roof surface (loading conditions 10-12)

TABLE II—AVERAGE STRESSES FOR TEST LOADS OVER WHOLE ARCH

Unit Stress in Kips per Sq. In.

Member	Loading Increment 10 to 11 8 lb. per sq. ft.	Loading Increment 10 to 12 18 lb. per sq. ft.	Dead* Plus 100 percent Live Load (Experimental)	Dead Plus 100 percent Live Load (Theoretical)
X-1	?	−7.5	−11.4	−10.9
X-1′	−2.4	−5.2	− 8.0	−10.9
X-21	−4.4	−9.5	−14.5	−11.3
X-21′	−4.1	−9.7	−14.7	−11.3
X-39	−4.1**	−9.9**	———	−11.3
X-39′	−2.2	−8.4	−12.8	−11.3
A-1	+1.8	+2.7	+ 4.1	+ 3.0
A′-1′	+1.7	+3.0	+ 4.5	+ 3.0
N-22	+2.3	+4.7	+ 7.2	+ 7.6
N′-22′	+3.2	+6.1	+ 9.3	+ 7.6
V-38	−1.1	−0.9	− 1.4	− 1.5
V′-38′	−2.1	−1.4	− 2.1	− 1.5
1-2	−1.6	−3.1	− 4.8	− 5.2
1′-2′	−2.0	−4.5	− 6.8	− 5.2
10-10	−0.4	−2.7	− 4.1	− 1.8
10-10′	−0.3	−2.3	− 3.5	− 1.8
W-39	−1.8	−3.7	− 5.6	− 4.1
W-39′	−0.8	−0.9	− 1.4	− 4.1

* Calculated by proportion from stresses caused by loading increment 10–12, which corresponds approximately to 18 lb. per sq. ft. of horizontal projection of roof area.

** Upper surface of outstanding legs. Average stress could not be determined because straight-line variation could not be assumed, due to twist and high stress on vertical legs.

TABLE III—VALUES FOR MODULUS OF ELASTICITY

Member	Location	Thickness In.	Modulus of Elasticity Psi.
Tie Rod		0.752	29,100,000
X-39	Bottom chord	0.306	28,000,000
X-39′	Bottom chord	0.309	28,600,000
X-21	Bottom chord	0.370	28,300,000
V′-38′	Top chord	0.187	29,400,000
P-26	Top chord	0.197	29,200,000
E′-6′	Top chord	0.195	28,800,000
W-39	Diagonal	0.250	29,400,000
W-39′	Diagonal	0.252	29,600,000

Point of failure anticipated

When loading condition 12 was achieved, it was evident that the bottom-chord members at the crown, X-39 and X-39′ were being severely punished. In fact, a twisting or bending of the hinge details in a plane perpendicular to the plane of the arch was clearly observed through a transit telescope. The bending in the plane of the arch was much more severe, however, and it was evident from the strain readings that member X-39 was reaching a critical stage. Consequently, this member was switched in on the control box during the loading of the water tanks leading to loading 13—dead plus 175 percent live load on the whole arch.

While eleven of the thirteen tanks received their load increments, the slow displacement of the illuminated galvanometer spot on the control box indicated that the stress was increasing slowly as the load was being applied. As water poured into the twelfth tank, which was adjacent to the center receptacle, the illuminated galvanometer spot started to move more rapidly. It suddenly accelerated and vanished out of the range of the graduated glass panel on which its movement had just been noted. A second later, with the failing of X-39, the arch collapsed.

Stressed beyond the yield point, the toes of the angle legs that were back to back in X-39 had buckled out-

ward at a point about halfway between a tie bolt (ring fill) and the end connection, and then the member had folded up into a V-shape (Fig. 5). The break occurred at a point very close to an electric gage station.

Plane-section assumption inexact

Attention is called to the stress profile on the vertical axis of X-39 in Fig. 4. For the load increment 10-12, the stress at the toe, plotted on the assumption of a straight line variation, greatly exceeded the yield point of the material, which was found in a subsequent laboratory test to be 39,400 psi. As indicated in Table II, the average stress for this member, namely, the stress at the center of gravity, was not tabulated because a straight line variation of stress gave results that were obviously incorrect.

Even if the unit stress at the toe had not reached the yield point, the assumption of a straight line variation of stress in a two-angle member such as this, subject to severe bending in two directions, is open to question. Considering the member as a whole, plane sections probably do not remain plane.

Moreover, the proportional limit may be considerably below the yield point, and after the proportional limit of the material has been passed, the tangent modulus becomes increasingly less than the initial modulus of elasticity. Hence, strain cannot be converted to stress on a straight-line basis in the higher ranges.

Members subject to combined stress

It is obvious from the stress profiles that bending as well as direct stress was acting on every member. This is to be expected, not only because of the presence of secondary bending stresses induced by bolted joints and gusset plates, but also as a result of slight, unavoidable curvatures and accidental eccentricities in members. Bending moments were also induced by the definite eccentricity of gage lines of bolts with respect to centers of gravity of the members.

The member that failed—X-39—and its counterpart in the other half arch—X-39′—exhibited severe bending in two planes, one the plane of the arch and the other the plane at right angles to it. Unquestionably, the details at the crown hinge were responsible. Bending in the plane of the arch

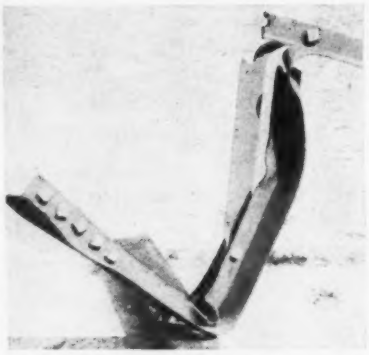

Fig. 5. A bottom-chord member failed when the toes of the angle legs that were back to back buckled outward.

at this joint was due to the fact that the hinge assembly was connected only to the vertical legs of the bottom chord (Fig. 6).

Moreover, bending in the plane perpendicular to the plane of the arch was induced, under unbalanced loadings, by the two single-angle diagonals in the panels at the center. These diagonals at the crown hinge were connected on the same side of the gusset plates. Most of this bending probably could have been eliminated by using double-angle diagonals at the crown.

Arch truss performed well

Numerous readings on the deflections of each panel point and the movements of the footings were obtained during the sequence of loading tests from level and transit stations accurately established on a line parallel to the arch. These observations were under the direction of A. Krohn, field engineer. Detailed results are not presented herein. Suffice it to say that the deflections were not excessive, even though the truss joints were bolted instead of riveted.

As noted previously, the arch failed at a loading which was just short of load condition 13 in Table I—dead load plus 175 percent live load. The behavior of the structure under test was highly satisfactory to the representative of the Corps of Engineers, H. F. Carey, chief of the Structural Branch, Engineering Division, Military Construction. It was felt that the arch exhibited a factor of safety high enough for a structure to serve wartime needs.

Nevertheless, on the basis of the strain-gage tests and observation of the buckled member, a slight modification of the crown-hinge detail and the use of double diagonals in the two center panels at the crown were recommended. The changes added little to the cost of the arch, and it was estimated that their adoption would make it capable of supporting dead plus at least 200 percent live load before failure. Under this loading, no member would be subject to excessive direct stress or buckling load, according to calculations, even assuming pin-end conditions for compression chords.

The writer acknowledges with appreciation the permission of the Office of Chief of Engineers, U. S. Army, for the publication of this article. H. F. Carey reviewed and approved design, erection and testing for the Army engineers. Loading tests were made under the supervision of Peter A. Strobel, who retained the writer to serve as consultant on the strain measurements and stress interpretation.

DESIGN AND ERECTION OF PORTABLE HANGAR

The hangar previously described was designed to meet very rigid specifications. Planned mainly for overseas use for servicing B-29's, it had to be lightweight for conservation of steel and transportation facilities, easy to erect, simple in design for ease in field handling, and composed of interchangeable parts. To make the problem even more difficult, the Army specified that the design should be such that the hangar could be erected without use of powered equipment.

Final plans called for a hangar built entirely of steel, 200 ft. long and 194 ft. wide, with twelve rolling doors at each end, providing openings 160 ft. wide and 25 ft. high. In addition, each end has a lift door 14 ft. wide by 10 ft. high above the rolling doors, giving a clear opening at the center of the hangar of 35 ft. to permit passage of the B-29 tail assembly.

The structural frame consists of 12 three-hinged arched trusses, 18 ft. on centers, with ties under the floor.

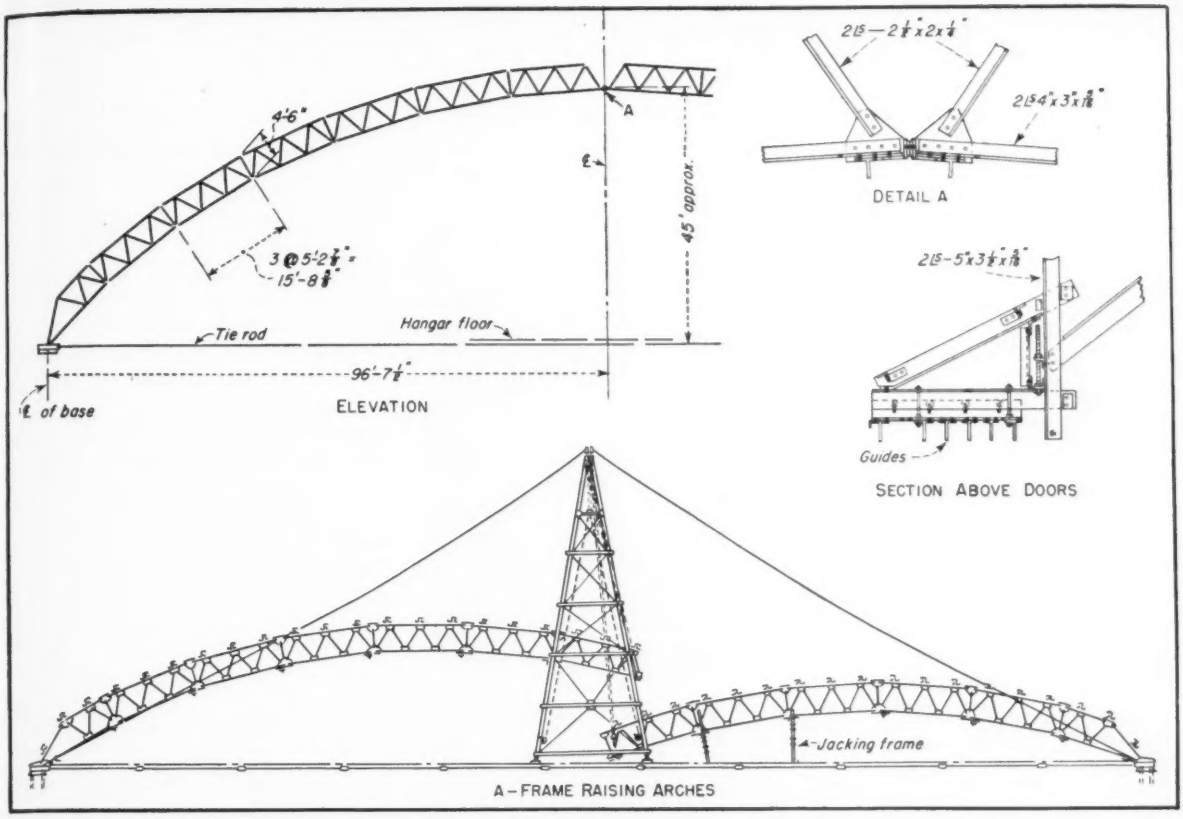

Fig. 6. General dimensions of the three-hinged arch are given in the elevation. Detail A is a close-up of the hinge at the crown. From the section above the doors it can be seen how, by turning a nut, the height of the door guides can be changed. And the bottom sketch indicates how the arch is erected, using an A-frame and special jacking frames.

Arches are braced in alternate bays at bottom chords and on the top chords carry 14 ga. Z-shaped purlins, which in turn support the corrugated steel roof.

Inclosures at the ends consist of corrugated siding fastened to girts hung from the end arches. A canopy at the top of the rolling doors supports the door guides and can be adjusted vertically to compensate for load and temperature deflections of the structure (Fig. 6). End framing and rolling doors are braced against wind loads to the adjacent arches.

Framed with light-gage steel members, the doors are covered with corrugated steel sheets and are of extremely light weight.

Most connections bolted

The connections of structural members, purlins, girts and door framing are bolted. For arches and end framing, ⅞-in. dia. bolts are used, for purlins and door guides ½-in. dia. bolts. On the main roof, corrugated sheets are fastened to purlins and to each other by sheet metal screws, but at the ends to the girts by clinch rivets and to the jamb of the vertical lift door by ¼-in. stove bolts.

Structural angles comprise frame

Using an allowable tensile unit stress of 24,000 psi., the hangar was designed for a live load of 20 psf. of horizontal projection and a wind load of 10 psf. normal to the structure, with consideration given to loading only half the arch. Evidently, it is not intended for use in areas with heavy snow.

To facilitate interchangeability of parts, a segmental, circular shape was selected for the arch. As a result, except for the gussets, only nine different types of pieces are needed, including the special end members. Small-sized structural steel angles are used practically throughout for the chord and web members.

To conserve materials, the A-frame tower used in erecting the structure is also built with some of the roof-framing pieces (Fig. 6).

Lighting consists of a row of five 1,500-watt lights mounted on alternate arches, with a total of five rows. Each lighting unit is equipped with a device for lowering it to the floor for use in servicing the planes.

The hangar is packed for export in 43 boxes, each weighing about 6 tons gross. To reduce the difficulties that the loss of any one box would develop, the main body of the hangar is packed with one-half bay to a box, and the ends, with doors, are also packed so that there are as many boxes alike as possible.

Erection procedure

In brief, erection consists of cutting trenches and placing tierods as the bases are set and braced. The trusses are assembled using special jacking frames and A-frame towers (Fig. 6), and braced pairs are raised in progressive order. Then, the struts and purlins in the unbraced bays are erected. Placing of roof sheets is begun when three bays of the structure are completed.

From Field and Office

WORKING PROBLEMS AND TIME-SAVING METHODS FOR ENGINEERS AND CONTRACTORS

FLAME-THROWING WEED-KILLER MOUNTED ON A "DUCK"

A flame-throwing weed-killer mounted on an army surplus "Duck" (above) about to enter a section of the All-American Canal from a rock-surfaced ramp. In the water the amphibious vehicle moves along the banks of the canal. The lower picture shows the "Duck" at work destroying a heavy growth of carrizo cane. The burner boom is 35 ft. long, swings 360 deg. horizontally and more than 90 deg. vertically. Weeds along a distance of between 3 and 4 miles can be burned in an 8-hr. day.

Decimal Point Location for Slide Rule Computations

In his article "How To Speed Up Slide-rule Work" (*ENR*, July 24, 1947, vol. p. 112) Lee Johnson states in part "In all cases the decimal point is set by inspection. Factors are rounded off and multiplied mentally or cancelled where possible." This in my estimation defeats the main purpose of a slide rule. The placing of the decimal point can be done very easily by algebraic summation of the characteristics of the individual factors. When using the C and D scales the following rules apply:

1. The characteristic of the product is equal to the sum of the characteristics of the factors if the multiplication is performed with the slide projecting to the right. If the slide projects to the left, then one must be added.

2. The characteristic of the quotient is equal to that of the dividend minus that of the divisor if the division is performed with the slide projecting to the right. If the slide projects to the left, one must be subtracted.

Example 1: Find the product of 37.3×12.2.

Place left index of C scale at 12.2 on D scale, and below 37.3 on C scale read 455. The slide projects to the right, and the characteristic of the answer is $1 + 1 = 2$. The answer has three places, thus 455.

Example 2: Find the product of 4.63×8.13.

Set right index of C scale to 8.13 on D scale, and below 4.63 on C scale read 376. Note that the slide projects to the left, and the characteristic of the answer is $0 + 0 + 1 = 1$. The answer is then 37.6.

Example 3: Find the quotient of $37.3 \div 4.63$.

At 37.3 on D scale set 4.63 on C scale. Under right index of C scale read 806. Note that the slide projects to the left, and the characteristic of the answer is $1 - 0 - 1 = 0$. The answer is 8.06.

Example 4 Find the value of

$$\frac{37.3 \times 12.2}{4.63 \times 8.13}$$

At 37.3 on D scale place 4.63 on C scale (slide projects to the left). Set cursor to right index of C scale. Bring 8.13 to hair line of cursor, and below 12.2 on C scale read 121 on D scale. The characteristic of the answer is $1 + 1 - 0 - 0 - 1 = 1$, and the answer is 12.1. In the second operation, the slide projects to the left during multiplication and division thus nullifying the effect of a projection to the left.

The above stated rules can be applied to any combination of scales with slight modification. With an inverted scale (CI) naturally the reverse of rules 1 and 2 is true. That is, the slide must project to the right before the characteristic of the answer is increased or decreased by one.

Example 5: Find the value of $3 \times 4 \times 2$.

At 3 on D scale place 4 on the CI

scale. Note that the slide projects to the right during this operation, the left index of the C scale indicating 12 on the D scale. The remainder of the operation utilizes the C and D scales, and no addition to the sum of the characteristics is required. The characteristic of the answer is $0 + 0 + 0 = 1$ making the answer 24.

With the use of the folded scales (CF and DF) and the inverted folded scale (CIF) the same principles apply. If the index of the CIF scale falls to the right of the hair line when the cursor is in place, no addition to the sum of the characteristics is made. If it falls to the left, one must be added.

Example 6: Find the value of $12 \times 11 \times 13$.

Bring hair line of cursor to 11 on DF scale. At 11 on the DF scale place 12 on the CIF scale. Note that the index of the CIF scale falls to the right of the hair line and indicates 132 on the DF scale. The DF scale and the CF scale would be identical to the C and D scales had the index been at the ends rather than the center of the rule. Therefore, the rule of the C and D scales applies to the use of the CF and DF scales. Above 13 on the CF scale read 1,716 on the DF scale. The characteristic of the answer is $1 + 1 + 1 = 3$ or 1,716.

Example 7: Find the value of

$$\frac{888}{12.2 \times 9.31}$$

To 888 on DF scale set 9.31 on CF scale. Note that the slide projects to the left; one must be subtracted from the algebraic sum of the characteristics. Above the CF index 95.4 is indicated. Above 12.2 on CIF read 781 on DF scale. The characteristic of the answer is $2 - 1 - 1 = 0$ making the answer 7.81.

The following rules are also very handy for locating the decimal point using other scales:

Involution with the D and A scales: If the square is found on the left hand A scale, the characteristic is double that of the original number, while if it is found on the right hand A scale, one must be added.

Evolution with the A and D scales: If the characteristic of the number whose square root is desired is even, the left hand A scale is to be used. If the characteristic is odd, the right hand one is to be taken. In the former case, the characteristic of the root is half that of the number, while in the latter case the characteristic is $\frac{C - }{2}$, C being the characteristic of the original number.

Cubing with the D and K scales: If the result is found in the last portion of K scale, it has three times the number of places that the given number has. If it is found on the middle portion, it has one place less. If it is found in the first portion, it has two places less. Thus, the result of $(2)^3$ is found in the first portion of the K scale and has $1 \times 3 - 2$ or one place. In $(3)^3$ the result has $1 \times 3 - 1$ or two places as it is found in the middle portion.

Extraction of cube roots with the K and D scales: Before beginning, the number should be divided into groups of three figures each, commencing at the decimal point and moving from right to left. If the first left hand group contains only one digit, the setting is made on the first portion of K scale. If it has two figures, on the middle portion, and if three figures, on the third portion. The cube root has as many places as the given number has groups.

Any time and motion saved by judicious choice of scales is lost by "doodling" to find the place of the decimal point. With the above methods, the characteristics may be added mentally, and the methods are fool proof to one who understands the use and construction of a slide-rule.

—SIDNEY L. GOLDBERG, *1416 Goodrich Ave., St. Paul 5, Minn.*

Longitudinal Finishing Screed

Construction of the concrete deck of Georgia's Chattahoochee River bridge was distinguished by the use of a 38-ft., 400-lb., all-aluminum, all-welded screed for finishing concrete pavement longitudinally.

The trussed screed was made up of a 4-in. pipe upper chord, a 6-in. lower chord, ¾-in. rods connecting the upper and lower members at two-ft. spacings, and large handles at each end fabricated of 2-in. pipe. The channel—the finishing element—was laid with the flanges pointing upward. Welded to the channel and threaded at the upper ends, the vertical rods passed through holes drilled in the 4-in. pipe. Curvature of the channel was set by means of rod nuts bearing on the top side of the pipes. The screed was designed so that it could be lengthened by the addition of sections at the center. Four men handled the screed with ease.

Do you have a new gadget—a new design method—a time- or labor-saving device—a how-to-do-it-better idea? Why not share it with others? *Engineering News-Record* pays $5.00 for all items accepted. Send a brief description along with photographs or drawings to:

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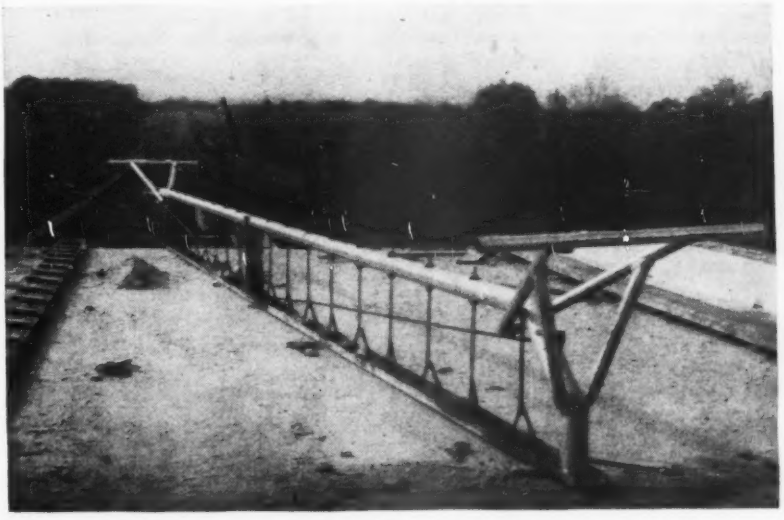


In Georgia a trussed screed was used recently to finish a concrete bridge deck.

Comment and Discussion

Readers' opinions on matters that concern engineers and contractors

Digester Scum Control

Sir: Apparently Frank L. Flood in his article (*ENR* June 26, vol. p. 1008) and L. L. Sphar in his communication (*ENR* Sept. 4, vol. p. 343) have overlooked the discussion of scum control by the writer, published in *Engineering News-Record* Feb. 21, 1946, vol. p. 289, and the earlier work described in *Industrial & Engineering Chemistry*, vol. 21, p. 322, April, 1929.

In the past 20 years, circulation such as that referred to by Mr. Sphar has proved satisfactory in many cases. However, the writer doubts the success of the second method described in the last paragraph of Mr. Sphar's letter. Similar structures experimented with in this laboratory and elsewhere have shown that at times the scum becomes too thick to permit the operation of rotating arms.

A. M. Buswell,
Chief, Illinois State Water Survey Division
Urbana, Ill.

Bridging the Hudson

Sir: The noble monument to an engineering still-birth shown in the accompanying photo is in the backyard of a large house at 12th and Garden Streets, Hoboken, N. J. A bridge from that point would have passed a bit north of Stevens Institute and would have landed in Manhattan in Greenwich Village.

Cornerstone of a forgotten project. It reads "The North River Bridge Co. Ground broken, June 8th, 1895. First foundation masonry laid June 18th, 1895."

Did you ever hear of this attempt to bridge the Hudson River at New York? Personally, I had never heard that plans to build a bridge that far back had reached the stage of starting to construct an anchorage on the Jersey side.

Henry D. Hammond
New York, N. Y.

Back in the Nineties two bridges across the Hudson River at New York were being actively promoted, this one of the North River Bridge Co. near 23rd St., and a railroad bridge near 70th St. for the New York and New Jersey Bridge Co. Delving back into the old issues of *Engineering News*, we find in the issue of July 11, 1895, a note to the effect that the charter of the North River Bridge Co. would have expired on that date had not something been done "to show the sincere purpose of the company to construct the work for which it had obtained power. It is to show this intention and to prevent their charter from expiring that work was quietly commenced some time ago on the New Jersey anchorage." The item goes on to say that the bridge was estimated to cost $36,000,000 and that plans were actively under way to sell bonds.—The Editors.

Books for Finland

Sir: Finland has an excellent and keenly scientific minded technical institute, Teknillinen Korkeakoulu. During the war its library was bombed and totally destroyed.

On my recent trip to Finland for the American Friends Service Committee, I discussed the situation with Martti Levon, director of the institute. He said he would welcome gifts of scientific and technical books and periodicals from America to take the place of those destroyed. In the remarkable efforts for recovery that the Finns are making, the lack of technical library facilities is a very serious handicap. It would be a practical act of friendship to a nation that holds America in high regard if Americans should contribute good technical books and periodicals to this library. Any such gifts should be marked for the Institute of Technology, Helsinki, and sent to the Legation of Finland, 2144 Wyoming Ave., N. E., Washington, D. C. K. T. Jutila, the Finnish Minister, will arrange for their being shipped to Finland.

Arthur E. Morgan
Member, A.E.S.C.
Yellow Springs, Ohio

Sewage Fertilizer Production

Sir: Based upon the information in the news item in the Aug. 28 issue of *Engineering News-Record* (vol. p. 294), "Milwaukee Sells Sludge", other cities would be interested in following Milwaukee's example. However, certain facts should bear careful analysis in any such contemplated program:

1. Manufacture of fertilizer from sewage sludge imposes a certain limitation upon the use of a sewerage system. Thus it is apparent that industrial wastes harmful to the fertilizer must be kept out.

2. The assembly line speed of fertilizer production must be maintained regardless of storm water flow. Thus the Milwaukee activated-sludge plant probably has to bypass more sewage direct to the lake than would be the case if emphasis were not placed on fertilizer production.

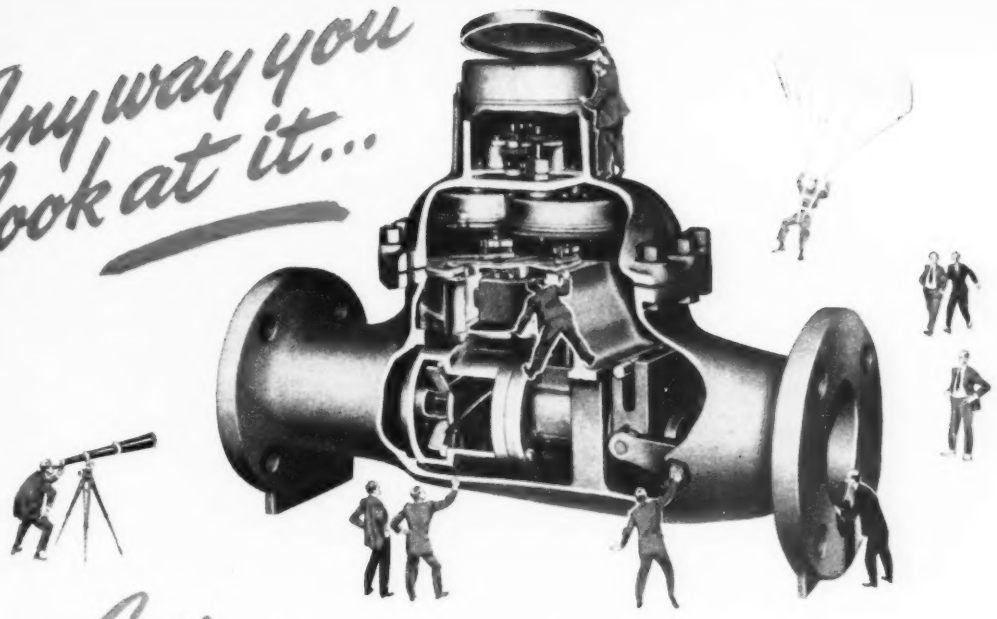
3. Long intercepting sewers are required to carry sewage to the disposal works for fertilizer production. Flooded basements and stream pollution resulting from overflowing intercepting sewers indicate the desirability of considering outlying sewage-disposal works.

4. In the light of the trend toward adding ground garbage to sewerage systems, it should be recognized that fibrous and non-nitrogenous garbage solids are not a desirable constituent of fertilizer. Thus, where fertilizer production is a paramount aim, garbage solids are not wanted.

5. The operating cost of 80 cents per capita per year reported in the *ENR* article does not include the capitalized cost of the large investment in long intercepting sewers and fertilizer production works.

Herbert Moore
Consulting Engineer
Milwaukee, Wis.

Any way you look at it...



You'll *Save* with this revolutionary compound meter

SAVE time reading meters; eliminate errors

In this meter alone, measurement by both the velocity and displacement metering units is recorded on a *single* register. This feature speeds meter reading and eliminates the possibility of error in reading and adding together the totals of the two registers normally used on compound meters.

SAVE in shipping, handling and installation

Size for size this meter is more compact and lighter in weight than other compounds. One man can install a three inch Pittsburgh-Empire without special handling equipment.

SAVE pressure absorption; gain greater accuracy

A horizontally positioned propeller, mounted on hard rubber roller bearings combined with a positive, swing action valve provides a straight-through flow stream; cuts pressure loss and retains accuracy at the changeover point.

SAVE on low flow rate accuracy

Pittsburgh-Empire compounds are fitted with sensitive, time-proven Empire oscillating piston displacement meters to accurately measure the extremely low flow rates that, over a period of time, can accumulate into a surprisingly large volume.

SAVE on maintenance and service

The space conserving interior arrangement of parts has been engineered for maximum maintenance ease and accessibility. All units dismantle through the meter cover and, if necessary, can be serviced without removing the meter from the line.

Write for Bulletin W-803

PITTSBURGH·EMPIRE *Compound*

PITTSBURGH EQUITABLE METER DIVISION

ROCKWELL MANUFACTURING CO. • PITTSBURGH 8, PA.

Atlanta Boston Chicago Houston Kansas City
Los Angeles New York Pittsburgh San Francisco Seattle Tulsa

MATERIALS AND LABOR PRICES

Market quotations on construction materials and wage rates reported monthly by ENR correspondents
November Materials and Labor Prices will appear in the November 13, 1947 issue.
Mexico City, Mexico prices will be published in this section of Engineering News-Record each month.

CEMENT, AGGREGATE, READY-MIXED CONCRETE — F. O. B. CITY

	PORTLAND CEMENT* Per bbl. C/L lots incl. $1.00 per bbl. for bags, cash. dis. not deducted			SAND AND GRAVEL Per ton, carload lots			CRUSHED STONE Per ton, carload lots		CRUSHED SLAG Per ton, carload lots, f.o.b. plant		CONCRETE BLOCK 8x8x16-in.; truckload del.; per block		CONCRETE Ready Mixed 1:2:4, over
	Cloth	Paper	Bulk	Gravel, 1½ in.	Gravel, ¾ in.	Sand	1½ in.	¾ in.	1½ in.	¾ in.	Sand grav.	Lt. wgt. Agg.	50 c.y. del.
Atlanta	$3.87	$3.07	$2.82	....	....	$1.75	$2.10	$2.10	$1.65	$1.85	$0.1725	....	$10.05
Baltimore	3.66	2.86	2.61	$2.10‡	$2.10‡	1.60‡	2.25‡	2.35‡	2.20‡	2.20‡	.145	$0.145*e*	8.55
Birmingham	3.42	2.57	2.32	2.06	2.06	1.63	2.50	2.50	1.00	1.20	.15	.15	9.95
Boston	4.13	3.33	3.08	1.50‡	1.50‡	1.40‡	1.25‡	1.35‡	....	....	.186	.195*w*	9.40*ii*
Chicago	3.65	2.85	2.60	2.50‡*d*	2.50‡*d*	2.75‡*d*	2.50‡*d*	2.50‡*d*	2.00‡	2.00‡	.195	.195*r*	....
Cincinnati	3.59	2.79	2.54	1.70‡*bb*	1.70‡*bb*	1.60‡*bb*	2.75‡*bb*	2.75‡*bb*	....	....	.17	.195	9.00*kk*
Cleveland	3.60	2.80	2.50	1.90*lli*	1.65*lli*	1.25*ll*	3.20‡*h*	3.20‡*h*	2.45	2.45	....	.20	10.40*ii*
Dallas	3.57	2.72	2.47	1.80	1.80	1.60	1.89	1.99	....	....	.0775*p*	....	8.68
Denver	4.03	3.23	2.98	1.85	2.00	1.15	....	....	....	....	....	.2245*w*	9.25
Detroit	3.40	2.55	2.30	2.75‡	2.75‡	2.50‡	2.50‡	2.50‡	2.50‡	2.50‡	.16*w*	.17*w*	8.30*kk*
Kansas City	3.65	2.85	2.60	1.85	1.85	1.40*t*	1.45*q*	1.45*q*	....	....	.16*w*	.175*aa*	9.35*n*
Los Angeles	3.50*eebv*	3.00*bv*	2.60*bv*	1.65‡*t*	1.75‡*t*	1.55‡*t*	....	1.65*t*	....	....	....	....	8.75*m*
Minneapolis	3.80*dd*	3.00*dd*	2.75*dd*	2.00*k*‡*j*	2.00*k*‡*j*	1.10*k*‡*j*	2.10*k*‡*j*	2.10*k*‡*j*	....	....	.183*cco*	....	9.65*jkk*
Montreal	....	2.17*r*	2.02*r*	1.78*bbs*	1.78*bbs*	1.10*e*	.95*es*	1.05*es*	....	....	.1391	.1515*w*	7.75*s*
New Orleans	3.43	2.58	2.33	1.82	1.82	1.62	....	....	.90	1.15	....	....	9.92
New York	4.70‡	3.70‡	....	1.85*de*	1.85*de*	1.30*de*	1.90*de*	1.90*de*	....	....	18/.20*ii*	.16/.18*ccii*	9.90*k*
Philadelphia	3.52‡	2.72‡	2.47‡	2.20‡	2.30‡	2.05‡	1.90‡	1.95‡	1.50	1.50	.20/.22	.20/.22*w*	9.25
Pittsburgh	3.51	2.66	2.41	1.90‡	1.90‡	2.20‡	2.35‡	2.35‡	1.90	1.90	.22*s*	.22*s*	....
St. Louis	3.62*o*	2.82*o*	2.57*o*	2.25‡*oh*	2.25‡*oh*	2.00/2.25‡*oh*	1.35*c*	1.35*c*	....	....	.195	.22*yo*	10.15
San Francisco	3.94*jj*	3.04	2.64	1.71	1.71	1.81	1.81	....	....	....	....	.25*y*	9.80*u*
Seattle	3.35*gg*	3.10	2.80	2.50‡*o f*	2.50‡*od*	2.50‡*o f*	3.00‡*od*	3.00‡*od*	....	....	.18*e*	....	8.75*o*

‡ Delivered. *a* F.o.b. truck at plant. *b* 20c. per bbl. off for payment by 10th of following month. *c* F.o.b. quarry. *d* Per cu. yd. *e* Barge lots alongside docks. *g* Pea gravel. *h* Truck Lots. *i* ¾ in. *j* 5% discount for cash. *k* Discount of 2 percent for cash in 10 days. *l* 2000 lb. concrete. *m* 50c. off for cash. *n* 25 c.y. or more. *o* 2% off for cash. *p* 5½ x 8 x 12 in. *q* F.o.b. plant. *r* 10¢ per bbl. off cash 20 days. *s* 8% sales tax included. *t* Truck delivery. *u* 10 to 100 c.y. brackets. *v* Does not include dealer's commission. *w* Cinder. *x* Waylite. *y* Haydite. *z* Celocrete. *aa* Aver. haul, 7-9 mi. zone. *bb* 5 tons or more. *cc* Also 8 x 8 x 18 in. *dd* Dealers sell only in LCL. This is price for CL and does not include dealer's commission. *ee* 20c refund for each returnable bag. *gg* 10c. refund for each returnable bag. *hh* Truck loads up to 500 c.y. Over 500 c. y. lots, 50¢ less per yd. *ii* Yard price. *kk* 2500 lb. compression strength. *jj* 30¢ refund for each returnable bag. *ll* Price at plant, called for.

* October prices have been adjusted to include dealer's commission except where indicated to the contrary.

CASH DISCOUNTS CEMENT to Contractors: truck delivery, 2% for cash on 10th of month; on carload deliveries, no trucking, same as dealer cash discount 10c. per bbl. for payment within 15 days of date of invoice. Subject discount 10c. per bbl. 20 days in Montreal.

CURRENT MAXIMUM PRICE BASES AT CEMENT MILL

Charge for bags not included. For cloth bags, add $1.05 per bbl.; 25c. refund allowed for each returnable bag; for paper bags add 25c. per bbl., not refundable.

	Bagged	Bulk		Bagged	Bulk		Bagged	Bulk
Buffington, Ind.	$2.10	$2.10	Ironton, Ohio	$2.05*	$2.05*	Universal, Pa.	$2.10	$2.10
Hannibal, Mo.	2.10	2.10	Northampton, Pa.	2.00	2.00	Waco, Tex. (Plus 9c. tax in Tex.)	1.95	1.95
Independence, Kans.	2.10	2.10	Richard City, Tenn.	2.10	2.10	Montreal City (Discount 10c. per bbl. 20 days)	1.88	1.88
* Destination price base effective Aug. 14, 1947			Steelton, Minn.	2.20	2.20			

PAVING BRICK, BLOCK, ASPHALT, ROAD OILS — F. O. B. CITY

	PAVING BRICK AND BLOCK: Granite per M lots of 50,000 4x4x8 in.	Brick per M 3x4x8½ in. carload lots	Wood per sq. yd. 3½ in. 16-lb. treat	PAVING ASPHALT Per ton, less than 80 penetration: Tank car	Drums	ASPHALT BINDERS—FLUXES Per gal., 80-300 penetration: Tank car	Drums	CUTBACK ASPHALT Per ton: Tank car	Drums	ROAD OIL Per gal.: Tank car	ASPHALT EMULSION (Quick-breaking) Per gal.: Tank car	Drums
Atlanta	$73.00	$35.00	$2.25	$14.00	....	$0.074	....	$0.0806*h*	.....	$0.0781	$0.0806	.....
Baltimore	150.00‡	52.70‡	.....	15.00	$21.00	.135	$0.09	13.00	$23.00	.122	.10	$0.14
Birmingham	.....	32.00	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Boston	85.00	59.00	3.75	17.00*o*	29.50*o*	.0723*o*	.1447*o*	.075*ho*	.15*ho*	.07*o*	.0907*o*	.18*o*
Chicago	150.00‡*y*	72.00/74.00*e*‡	2.97/4.10*d*‡	18.00/19.00*b*	27.00/27.50*b*	17.50*bg*	24.50/25.00*bg*	.085/.0875*bh*	.17/.1725*bh*	.0675/.07*b*	.0925/.1025*b*	.14/.165*l*
Cincinnati	.....	.....	.....	19.40*z*	.....	.....	.....	.....	.....	.....	.....	.....
Cleveland	185.00	47.00*z*	3.43	24.50	36.00	24.50*g*	36.00*g*	.105*h*	.24*h*	.11	.135	.24
Dallas	*l*	40.00	*l*	16.95	29.15	.0686	.1225	20.00	37.60	.05	.0675	....
Denver	.....	38.00	.....	.....	.....	.....	.....	22.50	.....	.....	.....	.....
Detroit	.....	63.00*z*	.....	20.00	26.00	18.40*g*	24.40*g*	.0811*h*	.128*h*	.075	.1085	.1522
Kansas City	.....	40.00	.....	17.60	.....	16.00*g*	.....	.075*h*	.....	.0675	10	.....
Los Angeles	*l*	.....	*l*	12.50*bf*	.....	.....	.....	13.00*b*	.....	*.04*b*	.10*b*	.20*b*
Minneapolis	.....	.....	2.39*d*	23.00	32.00	17.00*g*	28.00*g*	23.00	33.00	.08	.09	.15
Montreal	100.00	.....	.....	16.60*k*	24.25*k*	11.60*kp*	14.85*kp*	11.50*kp*	13.50*kp*	.08*kj*	.135*k*	.188*k*
New Orleans	.....	.....	.....	15.50*a*	.....*s*	13.50*ga*	.....*s*	6.75*a*	.....*s*	.055	.08	.13*n*
New York	.....	.....	2.50*d*	20.68	32.85*a*	19.68*g*	38.68*g*	.0857*h*	.1669*h*	.0807	.0855	.1643
Philadelphia	150.00	62.00	4.06	19.00	.....	17.00*g*	.....	.08*h*	.....	.....	.....	.....
Pittsburgh	142.00	42.00	3.90	20.00	30.00	.10	.20	22.00	34.00	.08	.09	.18
St. Louis	.....	42*00	.....	16.50/17.00	22.50/23.00	15.50/16.00*g*	21.50/22.00*g*	.075/.08*h*	.165/.17*h*	.065/.07	.075/.09	.125/.155
San Francisco	.....	54.00*c*	.....	13.00	26.50*w*	13.00*g*	.....	13.50	.....	.....	.0575	.1275
Seattle	.....	.....	.....	13.00*i*	27.00*i*	11.00*ig*	.....	13.50*i*	17.50*i*	12.50*ig*	.0575*i*	.0725*s*

‡ Delivered. *a* F.o.b. Baton Rouge. *b* F.o.b. Refinery. *c* 2½ x 8½ x 4 in. *d* 2-in. interior block, 6-lb. treatment. *e* 3½ x 4 x 8½. *f* 40-300 penetration. *g* Per ton. *h* Per gallon *i* F.o.b. Martinez. *j* Shipped in drums. *k* Tax included. *l* No used *n* 55 gal. drums. *o* Price at plant. *p* Per 100 gal. *s* Drums not available. *t* Truck deliveries in Greater Cleveland *w* Shipped in double head wood barrels. *x* Truck deliveries in Detroit $75.00. *y* Carload lots. *z* 50-300 penetration.

IRON AND STEEL PRODUCTS — BASE MILL PRICES

	STRUCT. SHAPES–PLATE/	REINF. BARS billet *be/*	RIVETS ½-in. structural/	WIRE NAILS Base *d/*	SHEET PILING Base/	STEEL RAILS Per Net Ton Standard	Light	Re-rolled	TRACK SUPPLIES/ Angle Bars	Std Spikes *c*	Tie Plates *c*	Track Bolts
Birmingham	$2.80	$2.75	$5.25	$4.25	....	$55.00	$62.00	Not	$3.25	$4.00/4.50	$3.05	$7.00
Chicago	2.80	2.75	5.25	4.25	$3.30	.....	.....	avail-	3.25	4.00/4.50	3.05	7.00
Pittsburgh	2.80	2.75	5.25	4.25	3.30	55.00	62.00	able	3.25	4.00/4.50	3.05	7.00
Buffalo	2.80	2.75	....	....	3.30	.....	.....	....	....	....	3.05	....
Cleveland	....	2.75	5.25	4.25	....	.....	.....	....	....	....	....	....
Youngstown	....	2.75	....	....	....	.....	.....	....	....	4.00/4.50	....	....
Detroit	....	....	....	....	....	.....	.....	....	....	....	....	....
Gulf ports	....	....	....	....	....	.....	.....	....	....	....	....	....
Geneva	2.975‡	....	....	....	....	.....	.....	....	....	....	....	....
Los Angeles	3.44/3.47‡	3.325‡	....	....	....	.....	.....	....	....	....	....	....

‡ Delivered. *b* Rail steel price upon application. *c* Other basing points include Portsmouth, O., Weirton, W. Va., St. Louis, Kansas City, Minnequa, Colo., and Pacific coast ports. On tie plates alone, Steelton, Pa.; on spikes alone, Lebanon, Pa., Richmond, Va. *d* Add switching charge $18 per CL. *e* Mill lengths. Add 50¢ for cut lengths. */* Per 100 lbs.

IRON AND STEEL PRODUCTS — F. O. B. WAREHOUSE, PER 100 LBS., BASE PRICE

	STRUCTURAL SHAPES Per 100 lb base price	REINFORCING BARS *g* Per 100 lb., base price *u* 5 tons to carload lot *b* New billet	Rail steel	Add $/cwt. for Switch	Del.	EXPANDED METAL LATH *k* Per 100 sq. yd., carload lots Std. diamond mesh, 3.4 lb.	Std. ribbed 3.4 lb.	WELDED FABRIC REINFORCING Per 100 sq. ft., carload lots 4x16 in., No. 5 & 10 wires	4x12 in., No. 8 & 12 wires	6x6 in., No. 6 & 6 wires Per 100 s. f.	SHEET PILING Per 100 lb. base price.
Atlanta	$5.02‡	$5.12‡	$5.12‡	$.025	$.10	$31.00	$33.00	$2.20	$1.71	$2.33	....
Baltimore	4.25	3.935*l*	....	....	.10	35.00	37.00	2.07	1.62	2.20	$4.25
Birmingham	4.10	4.25	4.25	.05	.10	37.50*p*	40.50*p*	2.18	1.70	2.31	....
Boston	4.92‡	4.65‡	4.09*a*	....	.10/.15	29.00	31.00	2.13	1.66	2.26	3.753*k*
Chicago	4.40	.....	....	.05	.05	27.00‡	29.00‡	2.04	1.60	2.16	3.30*x*
Cincinnati	4.74‡	3.819*c*	3.819*c*	....	....	35.00‡*s*	36.00‡*s*	2.02	1.61	2.16	3.64*d*
Cleveland	4.611	3.54†*c*	....	....	.10	29.00	31.00	2.02	1.60	2.15	....
Dallas	6.72	5.50	5.50	....	....	29.15	31.35	2.32	1.79	2.44	....
Denver	5.80	5.62*e*	....	....	....	36.00	41.00*q*	2.37	1.82	2.51	....
Detroit	4.72‡	4.691	4.691	....	.10	33.00*z*	35.00*q*	2.05	1.61	2.17	3.6193*yd*
Kansas City	5.15*ee*	4.34†*aak*	4.34†*aak*	.0	.05	34.00	36.00	2.16	1.69	2.29	3.78*k*
Los Angeles	5.30/	4.43	4.28	.03	.05	30.50	32.50	2.32	1.79	2.46	....
Minneapolis	4.734‡	4.774*ccn*	4.774*ccn*	.0	.10	29.50*k*	31.50*k*	2.18	1.70	2.31	3.77*k*
Montreal	4.55*i*	4.20*i*	4.20*i*	....	....	36.00*A*	38.70*A*	2.87	3.54*i*	2.96*im*	73.00*jd*
New Orleans	....	4.63*ok*	....	.05	.10	27.50	29.50	2.20	1.71	2.33	.....
New York	4.32*r*	4.40	....	....	15/.20	30.00*st*	32.00*st*	2.41	1.67	2.53	3.35*a*
Philadelphia	4.52	4.59	....	....	....	30.00‡	32.00‡	2.08	1.63	2.20	3.41
Pittsburgh	4.40	4.55	4.55	.05	.10	26.00	29.80	1.94	1.54	2.06	5.05
St. Louis	4.699‡	3.84*c*	3.84*c*	.0	.03	34.00‡	36.00‡	2.05	1.62	2.17	....
San Francisco	5.10*k*	4.53*k*	....	....	....	32.50	34.50	2.32	1.79	2.46	4.85
Seattle	3.628*s*	4.43*e*	....	....	....	43.00*w*	46.00*w*	2.32	1.79	2.46	4.355*dd*

‡ Delivered. *a* Mill prices. *b* 1–5 tons, add 35¢. Less than 1 ton, add 50¢. *c* 20 tons or over base. *d* Mill price plus freight. *e* F.o.b. plant */* Includes delivery in free delivery zone. *g* High scrap steel prices cut former 15¢. differences between new billet and rail steel. *h* List price. Dominion tax exempt. Provincial and Municipal tax extra. *i* Plus Dominion, Provincial and Municipal sales tax. *j* Price per ton. *k* F.o.b. city. *l* Intermediate. *m* Per sq. yd. *n* 5 to 8 tons base. *o* 5 to 15 tons base. *p* Del. of 5000 sq. yd. or less. *q* Std. ribbed. 4 lb. per sq. yd. *r* 5 tons or over. *s* LCL. *t* Asphalt coated. *u* Note: Revised size extra—1 in., 1¼ in. 10¢, ¾ in., ⅞ in. 15¢, ⅝ in. 20¢, ½ in. 35¢, ⅜ in. 55¢, ¼ in. $1.30. *v* Under 20 tons. Straight. *w* Copper bearing. *x* 2.5 lb. per sq. yd. *y* $.0093 transportation tax included. *z* Copper alloy. *aa* 20 tons base. *cc* F.o.b. cars Chic. plus freight. *dd* F.o.b. dock. *ee* F.o.b. cars. † Price includes quantity and size charge but no switching charge.

PLUMBING, HEATING, WATER, SEWER AND DRAIN PIPE

	C. I PIPE Per net ton f.o.b. 6 in. to 24 in. *a*	VITRIFIED SEWER PIPE Per foot, Delivered ASTM C13–44T std. 8 in. s.s.	std. 12 in. s.s.	24 in.	36 in.	CLAY DRAIN TILE ASTM C4–24 Per 1,000 ft., carload lots, f.o.b. 6 in.	8 in.	CONCRETE SEWER PIPE Per ft., delivered, ASTM C 14–41 12 in.	24 in. *	WROUGHT STEEL PIPE (Full standard weight, f.o.b. destination *z*) 2½ & 3 in., Butt Weld** Black %	Galv. %	3½ to 6 in., Lap Weld Black %	Galv. %
Atlanta	$79.78	$0.43	$0.67	$3.39	$7.00	$114.00	$140.00	$0.45	$2.00	50.7	36.2	46.7	31.7
Baltimore	84.10	.378	.729	3.105	8.098	147.00	228.00	.80	2.20	54.4	39.9	50.4	35.4
Birmingham	74.50	.375	.675	3.06	....	210.00‡	375.00‡	.75	....	50.7	36.2	46.7	31.7
Boston	86.70	392*uvx*	.756*uvx*	3.465*uvy*	8.7125*uvy*	150.00	233.40	1.03*jcc*	2.76*jcc*	52.7	38.2	48.7	33.7
Chicago	85.06	54	1.04	4.12	12.80	150.00‡	270.00‡	.65	2.25	56.5*t*	42.0*t*	51.5*t*	36.5
Cincinnati	83.86	.406	.783	4.00	12.00	155.00‡	240.00‡	.54	1.98	54.9	40.4	50.9	35.9*t*
Cleveland	85.54	.329*x*	.6345*x*	2.79*x*	7.38*x*	127.00	190.00	.58	2.25	57.15	42.65	53.15	38.15
Dallas	87.28	.375	.675	2.70	6.20	109.00	131.00	.45	1.45	48.8	34.3	44.8	29.8
Denver	92.12	.38	.68	2.84	....	.....	.....	.64	2.25	46.9	32.4	42.7	27.7
Detroit	85.54	.455	.8775	3.69	8.50	170.00‡*m*	260.00‡*m*	.50	1.90	55.4	40.9	51.4	36.4
Kansas City	86.62	.39	.705	2.78	6.85	175.00	310.00*m*	.50	1.70	52.2	37.7	47.8	32.8
Los Angeles	98.50	.414†	.894†	3.77‡	9.689‡	188.38‡	313.20‡	....	....	....	....	....	....
Minneapolis	88.60	.51*mo*	.98*mo*	3.95*mo*	....	.....	.....	1.05*h*	2.90*h*	52.3	37.8	47.9	32.9
Montreal	78.20	.68*s*	1.20*s*	3.94*s*	6.38*es*	.48*paa*	.68*paa*	72.00*jkaa*	218.00*jkaa*	....	....	....	....
New Orleans	82.18	.40	.72	3.06	....	220.00*bb*	.....	.55	1.95	50.3	35.8	46.3	31.3
New York	83.30	.59	1.09	4.24	10.79	.....	.....	1.00	2.25	53.7	39.2	49.7	34.7
Philadelphia	81.70	.50	.95	3.95	9.75	220.00‡	275.00‡	1.05*h*	2.75*h*	54.2	39.7	50.2	35.2
Pittsburgh	86.02	.357*m*	.6585*m*	2.70*m*	6.625*m*	126.20	197.40	1.05*h*	2.50*g*	57.5*t*	42.0*t*	53.5*t*	38.5*t*
St. Louis	83.38	.40	.72	2.88	6.53	.....	.....	1.10*il*	2.30*il*	54.1	39.6	49.2	34.2
San Francisco	98.50	.4375*d*	.7875*d*	3.15*d*	7.875*d*	159.00*dl*	265.00*dl*	.69	2.85	....	....	....	....
Seattle	100.30	.455	.81*b*	....	....	72.50*c*	.....	.595	1.80	....	....	....	....

‡ Delivered. † F.o.b. *a* B. & S. class B and heavier, CL, Burlington, N. J. (base) $79.50. Based on existing freight rates; subject to rate change. Gas pipe and class A, $5 per ton additional. 4 in., $5 per ton additional, 30 in. and larger, usually $1 per ton less. *b* Extra strength ASTM C 200–44 T. *c* 4-in. *d* SS361-A. *e* 30 in. *g* Culvert pipe. Reinforced, ASTM C76–41. *h* Reinforced. ASTM C75–41. *i* Reinforced. ASTM C76–37. *j* Centrispun. *k* Per 100 ft. *l* F.o.b. plant. *m* Truck delivery. *o* Listed price is based on LCL (no minimum). *p* Less than 5 ton loads, price per ft. *s* Discounts from standard list consumers carload prices. Base price approx. $200 per net ton. List prices per ft.: ½ in., 8½c.; ¾ in., 11½c.; 1 in., 17c.; 2 in., 37c.; 2½ in., 58½c.; 3 in., 76½c.; 4 in., $1.09; 6 in., $1.92; 3 percent tax on transportation costs not included. *t* Within switching limits. *u* ASTM C13–40. *v* F.o.b. city. *x* 2 ft. lengths. *y* 3 ft. lengths. *z* CESA A60-1941 specifications used. *aa* No standard specifications in Can. *bb* Freight allowed to destinations in city. *cc* Truck loads; f. o. b. plant, Newton. ** **Discounts now quoted separately on different sizes. Discounts on "2½ & 3 in." to replace previous series.**

WROUGHT IRON PIPE: List prices per ft. same as wrought steel pipe. Discount for Pittsburgh base. Butt weld—1 in. and 1¼ in. black, 34 galv., 16; 1½ in. black, 38 galv., 18½; 2 in. black, 37½, galv., 18. Lap weld—2½ in. to 3½ in. black, 31½, galv., 14½; 4½ in. to 8 in. black, 32½, galv., 17. Freight rates to destination to be added to name delivered price.

LUMBER, TIMBER, PLYWOOD—PER M FT., B.M., CARLOAD LOTS F. O. B.

	SHORT LEAF YELLOW PINE AND DOUGLAS FIR — All S. L. Y. P. is No. 2 common or better and for No. 1 N. C. Box. (Prices in Bold Face) — All Fir planks No. 2 common, Fir timber is No. 1 common. Lengths up to 20 ft. (Prices in italics)									LONG LEAF Y. P. Merchantable grade up to 20 ft.		PLYWOOD Rail freight increment (See note for base price)	
	1x6 s4s	1x8 s4s	2x4 s4s	2x6 s4s	2x8 s4s	2x10 s4s	3x12 Rgh	6x12 Rgh	12x12 Rgh	2x12 Rgh	12x12 Rgh	⅜"	½"
Atlanta	**$72 00**	**$72 00**	**$62 00**	**$62 00**	**$62 00**	**$62 00**	**$82 00**	.....	.....	.....	.....	**$18.60**	$22.70
	85 00	*85 00*	*95 00*	*95 00*	*95 00*	*95 00*	*85 50*	*$85 50*	*$85 00*	.....	.....	.....	.....
Baltimore	**86 80**	**88 00**	**88 00**	**86 80**	**90 20**	**94 60**	**104 50**	.....	.....	176.00	165.00	19.05	23 25
	96 80	*99 00*	*102 80*	*101 80*	*103 40*	*103 40*	*110 00*	*110.00*	*110.00*	.....	.....	.....	.....
Birmingham	**87 50**	**87.50**	**87 00**	**86.00**	**87.00**	**90.00**	**110.00**	.....	.....	110.00	112.50	18.15	22 15
	92 50	*92.50*	*92.00*	*91.00*	*92.00*	*95.00*	*114.00*	*97.00*	*98.00*	.....	.....	.....	.....
Boston	70.00[3]	72.00[3]	66.50[3]	68.50[3]	70.50[3]	74.50[3]	70.25[3]	.....	.....	.....	.....	19.05	23 25
	64.75i	*64.75i*	*62.75i*	*63.25i*	*62.75i*	*62.75i*	*60.50i*	*59.50i*	*59.50i*	*59.50i*	*59.50i*	.....	.....
Chicago ‡	**88.00**	**90.00**	**83.00**	**83.00**	**83.00**	**90.00**	**90.00**	.....	.....	115.00	115.00	15.60	19 00
‡	*93.00*	*93.00*	*90.00*	*90.00*	*90.00*	*95.00*	*95.00*	*95.00*	*95.00*	.....	.....	.....	.....
Cincinnati	**84.00**	**86.00**	**82.00**	**80.00**	**80.00**	**87.00**	**104.00**	.....	.....	95.00	120.00	18.15	22 15
Cleveland *k*	**110.00**	**110.00**	**110.00**	**110.00**	**110.00**	**115.00**	.....	.....	.....	.....	.....	18.50	22.60
k	*120.00*	*120.00*	*120.00*	*120.00*	*120.00*	*120.00*	*130.00*	*130.00*	*130.00*	.....	.....	.....	.....
Dallas	**59.00**	**59.00**	**56.75**	**57.75**	**59.00**	**61.50**	**61.00**	.....	.....	94.75	91.00	15.60	19 00
Denver	*95.00*	*95.00*	*96.50*	*96.50*	*96.50*	*96.50*	*105.00*	*110.00*	.....	.....	.....	11.60	14 15
Detroit	**86.00**	**86.00**	**86.00**	**86.00**	**86.00**	**88.00**	**88.00**	.....	.....	88.00	105.00	18.15	22 15
	98.00	*98.00*	*98.00*	*98.00*	*98.00*	*95.00*	*100.00*	*100.00*	*105.00*	.....	.....	.....	.....
Kansas City *a*	**85.00**	**85.00**	**85.00**	**85.00**	**75.00**	**80.48**	**95.00**	.....	.....	105.00	110.00	13.80	16 80
	90.00	*90.00*	*90.00*	*90.00*	*77.00*	*82.00*	*96.50*	*105.00*	*110.50*	.....	.....	.....	.....
Los Angeles *a*	*87.50*	*87.00*	*85.00*	*85.00*	*85.00*	*85.00*	*90.00*	*100.00*	*90.00*	.....	.....	11.15*gh*	13.55*gh*
Minneapolis ‡*b*	107.00[3]	107.00[3]	.....	.....	.....	.....	.....	.....	.....	.....	.....	13.80	16 80
‡*b*	*103.00*	*103.00*	*103.00*	*103.00*	*103.00*	*105.00*	*125.00*	*125.00*	*125.00*	.....	.....	.....	.....
Montreal *c*[4]	69.00	70.00	64.00	68.00	70.00	75.00	.....	.....	.....	.....	.....	.....	.....
	97.00	*97.00*	*97.00*	*97.00*	*97.00*	*97.00*	*87.00*	*87.00*	*87.00*	.....	.....	.....	.....
New Orleans	**60.00**	**60.00**	**60.00**	**60.00**	**60.00**	**65.00**	**105.00**	.....	.....	100.00	105.00	15.60	19.00
	61.00	*61.00*	*58.50*	*58.50*	*58.50*	*64.50*	*60.00*	*60.00*	*90.00*	.....	.....	.....	.....
New York ‡	**97.50/105**	**97.50/105**	**Range from $95 00 to $99 00**				**120.00**	.....	.....	.....	.....	19.05	23.25
‡	.....	.....	*Range from $105.00 to $115.00*				*105/115*	*110/120*	*110/120*	.....	.....	.....	.....
Philadelphia	**110.00**	**110.00**	**110.00**	**110.00**	**110.00**	**110.00**	**110.00**	.....	.....	150.00	150.00	19.05	23.25
	120.00	*120.00*	*120.00*	*120.00*	*120.00*	*120.00*	*120.00*	*120.00*	*120.00*	.....	.....	.....	.....
Pittsburgh	**59.40**	**61.80**	**71.35**	**63.60**	**69.45**	**73.10**	**84.85**	.....	.....	130.60	141.00	18.80	22.90
	77.60	*76.70*	*74.70*	*78.90*	*78.80*	*74.85*	*91.55*	*96.85*	*96.85*	.....	.....	.....	.....
St. Louis ‡*j*	**99 75**	**99 75**	**101 00**	**98 00**	**98 00**	**101 00**	**107 00**	*130.00*	*130.00*	108.00	108.00	15.60	19.00
‡*j*	*112 00*	*112 00*	*117 00*	*117 00*	*117 00*	*117 00*	*122 00*	.....	.....	.....	.....	.....	.....
San Francisco *d*	*74.50*	*74.50*	*74.50*	*74.50*	*72.50*	*74.50*	*74.00*	*74.00*	*74.00*	.....	.....	8.40*g*	10.25*g*
Seattle	*70.00i*	*70.00i*	*70.00i*	*70.00i*	*70.00i*	*70.00i*	*75.00i*	*75.00i*	*75.00i*	.....	.....	.....	.....

Bold Face type, Southern Pine. *Italics, Douglas Fir.* [3] Spruce. [4] Western Pine. No. 3 Common. ‡ Norway Pine. ‡Delivered. *a* Yard prices. *b* Retail prices, less than CL. *c* 5 M ft. or less. *d* Sales through wholesale distribution yard (F.o.b. purchaser's truck or carrier. San Francisco paid). *e* Tax exempt. *g* Lower rate by water shipment. *h* 50,000 lb. minimum. *i* No. 1 common. *j* Delivered in 5000 ft. lots. *k* These are retail yard prices quoted per truckload in Greater Cleveland. Less 2% for cash. Truck lots.

Note: Special concrete form grade Fir Plywood, 4' by 8' panels, 5-ply, sanded 2 sides, water resistant glue, carload lots, delivered per 1,000 sq. ft. surface. Seattle base price on ¼". $151.00; on ½". $171.00. For other centers add rail freight increment from table on proper size. For oiling add $3.00; for edge sealing add $2.00; for resin sealing add $8.50.

GLASS, EXPLOSIVES, CHEMICALS

	WINDOW GLASS — Discounts from jobbers list, Jan. 16, 1946 — Single or Double Thickness		EXPLOSIVES — Per lb. 40% Ammonia Gelatin in 50 lb. cases delivered in 200 lb. lots*	
	A quality	B quality		
Atlanta	76%	76%	$0.195	
Baltimore	70–10%	71–10%	.195	
Birmingham	68%	68%	.15	
Boston	77%	78%	.195	
Chicago	68%*e*	68%*e*	.195	
Cincinnati	67&10%*g*	67&10%*g*	.195	
Cleveland	67–10–10%	67–10–10–10%	.195	
Dallas	67%*e*	68%*e*	.2075	
Denver	68%	68%	.20	
Detroit	77%	76%	.195	
Kansas City	68.10%*g*	68.10%*g*	.195	
Los Angeles	.....	.....	.2025	
Minneapolis	68%	68%	.19	
Montreal	40–5%*ab*	40–10–5%*ab*	.2125	
New Orleans	68%	68%	.205	
New York	73%	74%	.265*f*	
Philadelphia	69%	70%	.195	
Pittsburgh	77–10%	77–10%	.1675	
St. Louis	70–10%	70–10%	.20	
San Francisco	66%	73%	.20	
Seattle	59%	60%	.2025	

Price of 60% Ammonia Gelatin is $0.0125 per lb. higher than 40%

a Discount from list, Sept., 1939; sales tax included, but 6% tax exemption not allowable for. *b* Single thickness. *d* Discount from jobbers list Sept. 15, 1928. *e* Discount from list of Jan. 29, 1947. *f* In borough of Kings, Queens and Richmond, and in Manhattan south of Canal St., add delivery charge of $6.00 per trip. *g* Discount from list of Aug. 15, 1938.

* Urban prices influenced by service charges or local storage and delivery regulations do not consistently reflect quantity prices in less congested areas.

40% Ammonia Gelatin price ranges in other than urban areas, per lb. (except Seismograph Grades)

	C/L 20,000 lb. net	Tons	200 lb. lots
E. of the Miss., except Fla. and Me.	$0.15	$0.175	$0.195
W. of Miss. to Rocky Mtn. States, Fla. and Maine	.155 – .1625	.18 – .1925	.20 – .2125
Rocky Mtn. States	.155 – .1675	.18 – .1975	.20 – .2175
Pacific N. W. States	.1525–.165	.1825–.195	.2025–.215
Pacific S. W. States	.15 – .1575	.18 – .1875	.20 – .2075

PILES, TIES F. O. B.

PILES

Prices per linear foot, fir and pine, bark on, f.o.b. cars, New York. Fir based on Wash. and Ore. points to New York shipping area; pine based on freight from Norfolk.

Dimensions	Points	Length	By Rail — Pine*	By Rail — Fir
12-in. at butt	6-in.	30 to 50-ft.	$0.34	....
12-in.— 2-ft. from butt	6-in.	50 to 59-ft.	.35	....
12-in.— 2-ft. from butt	6-in.	60 to 69-ft.	.36	....
12-in.— 2-ft. from butt	6-in.	90 to 100-ft.	....	.55
13-in.— 3-ft. from butt	5-in.	91 to 100-ft.	....	.59
14-in.— 2-ft. from butt	6-in.	50 to 69-ft.	.41	.66
14-in.— 2-ft. from butt	6-in.	70 to 79-ft.	.43	.60
14-in.— 2-ft. from butt	5-in.	80 to 85-ft.	.54	....
14-in.— 2-ft. from butt	5-in.	85 to 89-ft.	.57	....
14-in.— 2-ft. from butt	5-in.	90 to 100-ft.	....	.66

* Pine piling over 80-ft. available only in limited quantities.

RAILWAY TIES

Prices f.o.b. per tie for carload lots:		6"x8"x8' Untr.	6"x8"x8' Tr.	7"x9"x8'6" Untr.	7"x9"x8'6" Tr.
Boston	Oak	$1.45	.....	$2.00	.....
	Pine	1.35	$3.05*a*	1.90	$4.00*a*
New York	S. L. Sap Pine	1.65	2.85	2.00	3.30
	Mixed Oak	1.80	3.05	2.50	3.60
Birmingham	Hardwood	1.00	1.60*a*	....	2.25*a*
Chicago	Red Oak	....	2.50/2.60*a*	....	3.40/3.55*a*
Los Angeles	Douglas Fir	2.10	3.35*a*	3.00	4.80*a*
Philadelphia	Red Oak	2.25	3.05*ag*	3.00	4.15*ag*
St. Louis	White Oak	1.70	....	2.40	....
	Red Oak	....	2.25*a*	....	3.25*a*
	Sap Pine or Cypress	2.10	....	....	....
San Francisco	Douglas Fir	1.50*ef*	2.70*f*	2.00*bf*	3.78*caf*
Montreal	Birch or Maple	....*h*	....*h*	....*h*	....*h*

Tr. = Treated; Untr. = Untreated. *a* Creosoted. *b* 7" x 9" x 8'. *c* Empty cell. *e* Green. *f* F.o.b. cars. *g* January, 1943 price, none later available. *h* No constant price available.

CHEMICALS

Water, sewage treatment, road work, f.o.b. carlots, New York

Bleaching powder in drums f.o.b. works, per 100 lb.	$2.75– 3.00
Chlorine cylinders, liquid, per lb. delivered	.0675
Calcium chloride, 77–80%, flaked, 100-lb. paper bag, del'd, ton	24.00–40.50
Silicate of soda, 52 deg., in drums, f.o.b. works, per 100 lb.	1.55
Soda ash, 58%, in paper bags, per 100 lb. dense	1.28
Sulphate of aluminum, commercial, in 100-lb. bags	1.15–1.30
Sulphate of copper, in bbl., per 100 lb.	7.60

STRUCTURAL CLAY BUILDING TILE, BRICK AND LIME — DELIVERED

	STRUCTURAL CLAY TILE PARTITION — SCORED Per M. lots of 2,000 pieces or over, 3x12x12 in.	4x12x12 in.	8x12x12 in.	STRUCTURAL CLAY TILE — LOAD BEARING — SCORED Per M. lots of 2,000 pieces or over, 8x12x12 in.	10x12x12 in.	12x12x12 in.	BRICK Per M. in quantity Common backing	Straight hard	LIME Per ton, In paper, Carload lot, Hydrated finishing	Common hydrated	Pulverized, or lump
Atlanta	.....	.....	.....	.....	.....	.....	$24.00	$24.00	$19.00	$17.50	$17.50
Baltimore	$120.00	$126.00	$220.00	$240.00	$315.00	$340.00	24.00*k*	30.00*k*	22.50	17.50	2.75*m*
Birmingham	97.50	104.00	195.00	231.00	.....	.....	20.00*ff*	22.50*gg*	21.80	17.50	.....
Boston	105.00†	112.00†	210.00†	252.09†	.....	.....	20.00*i*	20.00*i*	21.00†	.....	16.00
Chicago	115.00	122.50	230.00	.....	.....	.....	20.00	21.00	24.00	18.00	.....
Cincinnati	120.00*j*	135.00*j*	170.00*jdd*	280.00*j*	.....	.....	27.50	27.50	25.60	23.20	.....
Cleveland	99.50*cc*	106.00*cc*	195.50*cc*	.....	.....	.....	25.50	25.50	21.15	19.15	22.15*ee*
Dallas	.....	83.00	.....	.....	.....	.....	18.00	20.00	28.00	22.00	.....
Denver	.....	.....	.....	.....	.....	.....	26.00	31.00	34.80*bb*	28.00*bb*	34.00*bb*
Detroit	126.00	134.00	252.00	285.00	370.00	423.00	26.00*f*	28.00*f*	28.00	26.00	26.00
Kansas City	.....	.....	.....	.....	.....	.....	16.00	18.50	34.00	30.00	30.00
Los Angeles	*r*	*r*	*r*	*r*	*r*	*r*	20.00	21.00	24.00	.....	25.00
Minneapolis	144.00*p*	160.00*p*	.....	160.00*wp*	.....	.....	22.00*xp*	.....	32.00*bbe*	24.00*bbe*	32.00*bbde*
Montreal	92.50*a*	98.50*a*	196.25*a*	151.50*aq*	.....	294.40*a*	22.16	31.86	12.50*ub*	14.00*u*	8.00*uo*
New Orleans	160.00	160.00	300.00	380.00	411.89	485.91	22.50	.....	21.20	18.00	14.10
New York	103.90	110.80	152.35*e*	166.70*hn*	.....	.....	28.00	.....	33.50	25.50	.....
Philadelphia	112.10	119.60	224.20	269.10	321.20	405.10	24.75	27.75	26.75	17.00	17.00
Pittsburgh	98.50	105.80	181.85	217.30	265.85	303.10	26.00	28.00*y*	19.40	16.90	2.85*m*
St. Louis	101.15	112.95	209.60	220.50	273.60	304.00	28.00*al*	25.00*s*	.65*aaap*	.50*aaap*	75*aaspee*
San Francisco	124.00	139.50	186.00*dd*	139.50*t*	.....	.....	27.50	.....	23.10	23.10	2.31*m*
Seattle	137.00*cc*	147.00*cc*	.....	147.00*ccw*	.....	.....	28.50	33.50	27.95*s*	27.95*s*	3.28*m*

† F.o.b. *a* Smooth. *b* Per 50 lb. bags. *c* 6 x 12 x 12 in.-3 cell. *d* Pulverized hot. *e* 5% discount for cash. *f* Includes $3.50 per M for truck delivery. *g* 5½ x 8 x 12. *h* F.o.b. Perth Amboy, N. J. *i* F.o.b. warehouse only. *j* Truck load or over. *k* $1.00 discount. *l* Red face. *m* Per bbl., 180 lb. *n* 7⅝ x-7⅝ x 12. Speed tile. *o* Per bbl., 200 lb. *p* Truck lots. *r* Not used because of earthquake danger. *s* 2% discount for cash. *t* 5½ x 8 x 11¼. *u* Tax exempt. *v* Sand lime. *w* 5 x 8 x 12. *y* Stacked. *z* Pebble lime price per 80 lb. sack. *aa* Price per sack. Lime not sold per ton. *bb* LCL. *cc* Truck delivery. *dd* 6 x 12 x 12. *ee* Pebble lime. *ff* 80% common. *gg* Select.

PAINT, ROOFING — F. O. B. CARLOAD LOTS

	RED LEAD Per 100 lb. in 600-lb. (Approx.) bbl. Dry *a*	WHITE LEAD Per 100 lb. in 100 lb. cases In oil *w*	READY-MIXED PAINT Per gal., drums Graphite *b*	Aluminum *c*	Ferric Oxide *d*	ROOFING SUPPLIES Carload lots f.o.b. factory Rolls, slate surfaced, 85–90 lb per sq.	Asphalt felt, per 100 lb.	Tar felt, per 100 lb.	Asphalt coating per gal.	Tar pitch 360 lb. bbl. per ton
Atlanta	$18.75	$27.375	$1.75	$2.70	$1.65	$2.06	$2.06	$2.06	$1.00	$36.00
Baltimore	18.50	27.00	2.25	3.50	2.75	2.50	3.00	3.00	.50	30.00
Birmingham	18.75	27.375	4.40	4.52	....	2.84	2.70	2.70	.40	34.50
Boston	18.50	27.00	1.75	2.50	2.31	2.00‡*h*	3.30‡*q*	3.30‡*q*	.25‡	21.00
Chicago	18.50	27.00	....	....	....	2.50‡	2.63‡*o*	2.65‡*o*	....	31.00‡
Cincinnati	18.50	27.00	....	3.15	1.90	2.21	2.26*o*	2.26*o*	37	34.00
Cleveland	18.50	27.00	3.00	3.00*a*	3.00	2.21	2.26*o*	2.26*o*	.31*y*	33.00
Dallas	18.50	27.00	....	4.05	....	2.69*q*	3.00*q*	3.15*q*	.90	45.00
Denver	18.50	27.50	2.88	4.38	2.63	2.04*o*	2.24*o*	.....	.42	32.00
Detroit	18.50	27.00	2.25	3.00	2.00	2.25	2.25	2.25	.50	25.00
Kansas City	18.50	27.125	3.30*g*	3.55*g*	3.16*g*	3.00	3.25	3.50	.54	.....
Los Angeles	18.75	27.50	3.20	4.60	4.00	2.80	1.90*e*	*l*	.60	*l*
Minneapolis	18.50	26.13*m*	....	....	....	2.10*im*	2.15*him*	2.15*him*	.37*m*	28.00*rm*
Montreal	.....	17.85	2.90*p*	4.20*p*	3.62*p*	2.85*t*	2.58*tf*	2.07*tf*	.68*t*	1.85*kt*
New York	18.50	27.00	3.45	....	3.45	2.10	2.15*o*	2.15*o*	.30*s*	26.00
Philadelphia	18.50	27.00	1.75/2.00	2.40	1.70	2.54	2.94	2.94	.37	26.00
Pittsburgh	18.50	27.00	1.98	2.50	1.90	2.32	2.37*o*	2.37*o*	.37	31.00
St. Louis	18.50	27.00	....	....	....	2.66	2.66	2.66	.38	29.00
San Francisco	18.75	27.25	1.80	2.75*n*	1.35	2.27*x*	3.30*nn*	....	.38*q*	.....
Seattle	18.75	27.50	2.95*m*	2.95*m*	....	3.00*mq*	3.07*hm*	....	.48*m*	35.00*jm*

‡ Delivered. Note: Red lead in oil 50c higher than white lead in oil. *a* Red lead prices change frequently due to pig lead price changes. *b* U. S. War Dept. Spec. 3-49A. *c* ASTM Spec. D266-31. *d* 80% minimum ferric oxide. *e* 15 lb per square. *f* Per 432 sq. ft. *g* 50 gal. drums. *h* Per roll. 65 lb. *i* Minneapolis and vicinity. *j* Asphalt pitch. *k* Per cwt. *l* Not used. *m* 1% discount for cash. *n* May, 1941 price. *o* Per 60-lb. roll. *p* Tax included. *q* Per 90-lb. roll. *r* F.o.b. factory Chicago. *s* ASTM Spec. D266-41. *t* Federal tax included. *w* Free to large paint contractors is $1.25 less. *x* Mineral surfaced. *y* 55-gallon container. *z* Drums. *aa* Approximate cost per 100 lbs.

SKILLED AND COMMON WAGE RATES — PER HOUR

	Bricklayers	Carpenters	Struct. Iron Workers	Hoisting Engineers	Plasterers	Electrical Workers	Steamfitters	Common Labor Building	Common Labor Heavy Const.
Atlanta	$2.00	$1.65	$2.00	$2.00	$2.00	$1.80	$2.00	$0.75	$0.85
Baltimore	2.80	1.95	2.15	2.20/2.40	2.00	2.00	2.00	1.10	1.10
Birmingham	2.25	1.625	1.90	1.60/1.875	2.00	2.00	2.00	.85	.95
Boston	2.15	1.90	2.00	2.25	2.00	2.15	2.00	1.40	1.40
Chicago	2.20	2.15	2.20	2.15	2.225	2.15	2.15	1.50	1.50
Cincinnati	2.25	1.975	2.10	2.00	2.125	2.125	2.125	1.25	1.15
Cleveland	2.25	2.125	2.25	1.875/2.125	2.125	2.125	2.125	1.50	1.40
Dallas	2.00	1.875	2.00	2.00	2.125	2.00	2.125	.95	.95/1.50
Denver	2.25*b*	1.875	1.875*b*	1.875*b*	2.25	2.05	2.05	1.275	1.35
Detroit	2.25	2.025	2.25	2.25	2.25	2.25	2.165	1.425	1.425
Kansas City	2.25	1.90	2.05	2.125	2.25	2.025	1.875	1.325	.90
Los Angeles	2.25	1.90	2.25	2.00	2.50	1.875	2.00	1.25	1.25
Minneapolis	2.075	1.80	2.00	1.85	2.25	2.06	2.00	1.30	1.30
New Orleans	1.9375	1.625	1.875	1.75	1.875	2.00	2.05	.90	.90
New York	2.75*b*	2.50*b*	2.75	2.75*b*	3.00*a*	2.25*a*	2.75*b*	1.50	1.50
Philadelphia	2.40/2.50	2.00	2.40	2.25	2.25	2.25	2.25	1.10	1.10
Pittsburgh	2.50	2.25	2.25	2.40	2.25	2.25	2.25	1.30	1.30
St. Louis	2.25	2.20	2.25	2.40	2.25	2.25	2.25	1.35	1.35
San Francisco	2.25	2.00	2.25	2.00	2.25	2.25	2.25	1.40	1.40
Seattle	2.235	1.935	2.135	1.95	2.235	2.135	2.345	1.535	1.45
Montreal*	1.40	1.06	1.11	1.00	1.17	1.11	1.11	.73	.67

a 6 Hr. day *b* 7 hr. day. * Cost of living bonus now included in basic wage.

MEXICO CITY PRICES

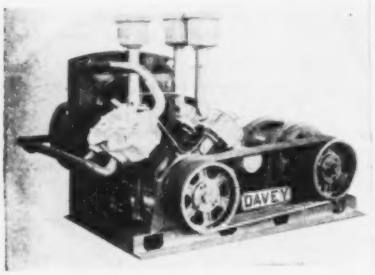
In Pesos, F.o.b. City		Aug. '47	Sept. '47
Common Wages—Building (8 hr. day)	av. per hr.	.57	.57
Common Wages—Heavy Const. (8 hr. day)	av. per hr.	.75	.75
Skilled Labor Wages			
Carpenters (8 hr. day)	av. per hr.	1.25	1.25
Bricklayers (8 hr. day)	av. per hr.	1.25	1.25
Struct. Iron Workers (8 hr. day)	av. per hr.	1.50	1.50
Struct. Steel Shapes 3"-15" x 12 meters	per ton	850.00	800.00
Reinf. Steel, Corr. Rods			
⅜" x 12 meters	per ton	940.00	1,000.00
½" x 12 meters	per ton	895.00	955.00
⅝" x 12 meters	per ton	880.00	940.00
¾" x 12 meters	per ton	880.00	940.00
⅞" x 12 meters	per ton	870.00	930.00
1" x 12 meters	per ton	865.00	925.00
Gravel, truck load of 3½ cu. meters			
Blue Gravel	per tr. load	35.00	35.00
Rose Gravel	per tr. load	32.00	32.00
Cement, Std. Port. (Tolteca)	per ton	120.00	115.00
Lumber			
Mex. Sacred Fir (Oyamel)	per M ft.	370.00	370.00
1st Class Pine	per M ft.	800.00	750.00
2nd Class Pine	per M ft.	550.00	450.00

ENR Skilled Average: (Bricklayers, Carpenters, Ironworkers) $2.120. **ENR Common Average:** $1.244.

New Aids to the Constructor

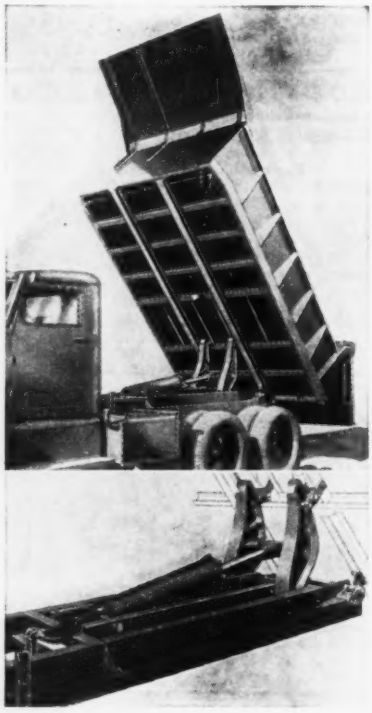
MANUFACTURERS' LATEST DEVELOPMENTS IN EQUIPMENT AND MATERIALS

TRACING VELLUM—Two different shading screens on tracings can be obtained with Craftint Doubletone tracing vellum. This is a drawing paper with hidden screens, in tracing vellum form. With it tones are brought up from the sheet with the quick application of a special colorless chemical. It provides a quick, easy way to shade art, do cross-hatching, trace finished art; it reproduces more economically. It is available in two types: Regular for preparing tracings for reproduction by contact printing, blue print, Ozalid, or similar methods and O.S. for preparing tracings to be photographed and reproduced by offset, rotogravure, or letterpress printing.—*Craftint Manufacturing Co., East 152nd St. at Collamer Ave., Cleveland 10, Ohio.*



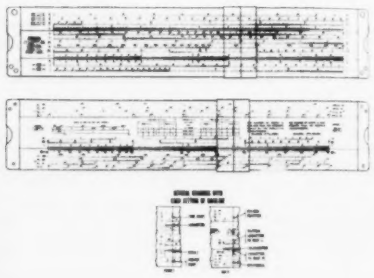
AIR COMPRESSOR—Complete new line of two-stage, air-cooled industrial air compressors of 60, 105, 160, 210 and 315-cfm. capacities features permanent peak efficiency valves and new Davey equi-balanced crankshaft, which is said to reduce compressor vibration to previously unachieved minimum. Its use, coupled with employment of modern rubber vibration mounts, makes possible elimination of heavy mounting bases and facilitates ready removal of units from one location to another.—*Davey Compressor Co., Kent, Ohio.*

WHEEL-TYPE TRACTOR — DW10 tractor has power output of 115-hp. at 1,800 rpm. Equipped with new No. 10 scraper, it offers outstanding digging and leveling characteristics. Coupled with matching wagon, it makes possible speedy handling of many types of materials. No. 10 scraper has heaped capacity (at 1.1 slope) of 11 cu. yd. New No. 21 rear-mounted, double-drum cable control is matched to requirements of this new tractor and scraper. Drum is 9-in. dia., 5 in. long, with 15-in. flange and capacity of 150 ft. of ½-in. cable.—*Caterpillar Tractor Co., Peoria 8, Ill.*



DUMP BODIES AND HOISTS—Designated as 300 Series dump bodies and No. 827 Iso-draulic roll-a-lift hoist, these new models are designed for rugged service. Bodies are carefully constructed of 8-gage high-resistant sheet steel, heavily braced at all points of stress. Design is such that at beginning of stroke, where lift is heaviest, greatest leverage is provided.—*Perfection Steel Body Co., Galion, Ohio.*

LEAD HOLDERS—Dixon Eldorado lead holders—163 single-pointed and 164 double-pointed—are precision instruments for the draftsman and engineer. Equipped with a patented clutch mechanism, they are unlike rubber grip holders in that they will not wear down or harden. The diameter of the grip is the same size as a regular drawing pencil, and the fluting on the grip keeps the fingers from slipping. The 163-S is designed to accommodate softer grades of No. 165 Eldorado leads. The 163-H is designed for harder degrees of No. 165 leads. The double-pointed 164 permits use of two different degrees of hardness in one pencil and has two movable indicators for identifying lead degrees. Hexagonal in shape, the pencil is 6 in. long.—*The Joseph Dixon Crucible Co., Jersey City, N. J.*



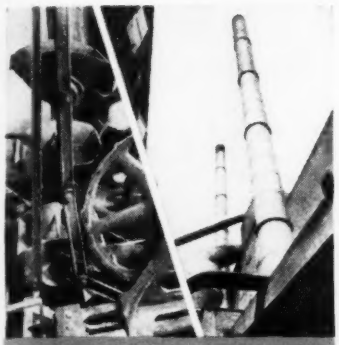
SLIDE RULE—A new Deci. Log slide rule has scales on the front of the rule so arranged that only one setting of the hairline gives with each result its square root, cube root and logarithm. The Log Log scale on the back is expanded for greater accuracy, and arranged to give these five readings with each setting of the hairline. The scales read from one ten billionth to ten billion, and give decimal point location. The slide rule is made of magnesium alloy with plastic surface bearing permanent, expanded, easy-to-read washable scales.—*Pickett & Eckel, Inc., 5 South Wabash Ave., Chicago 3, Ill.*

HEAT CONTROL—A new type of thermostat for electrical appliances that provides safe, constant, accurate, fast-acting heat control under the most severe operating conditions, the Fenwal Appliance Thermoswitch Control, maintains peak efficiency even though the appliance in which it is installed may be continuously exposed to shock, vibration, tampering and other outside influences. Two models are available—the high temperature model provides control over the range of 175-600 deg. F. The low temperature model provides control for low temperature applications throughout its range of

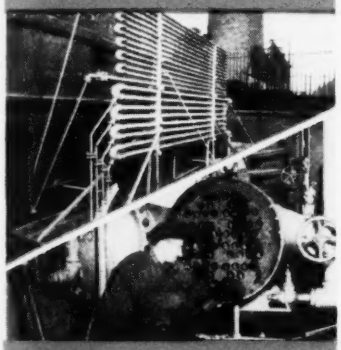
TO CURB EXCESSIVE MAINTENANCE

use BYERS WROUGHT IRON

IN THESE CORROSIVE SERVICES



FLUES & FUEL HANDLING EQUIPMENT



HEAT EXCHANGERS

BRIDGE & WATERFRONT CONSTRUCTION

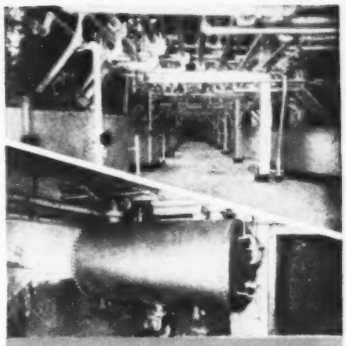
The true cost picture in heavy construction projects isn't given by construction estimates alone. It must include *maintenance* estimates also . . . and when these are included, the most durable materials generally show themselves as the most economical.

You'll find Byers Wrought Iron a dependable aid when you build for permanence. The illustrations suggest a few of the many places where it is successfully serving for others . . . and where it can serve and save for you. The use of wrought iron adds only a trifle to the overall cost of a project, and this small investment is returned many times over in extra service.

Wrought iron's unusual resistance to corrosion and to fatigue failure come directly from its unusual structure and composition, which are duplicated in no other material. Tiny fibers of glass-like silicate slag, threaded through the body of high-purity iron, halt and diffuse corrosive attack, and firmly anchor the initial protective scale, which shields the underlying metal. The fibers give a structure that might be compared to a stranded wire cable, and that withstands vibration and shock exceptionally well.

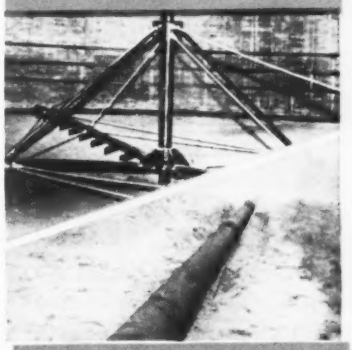
Our bulletin, "101 Uses for Wrought Iron" gives a picture-story of some of the current applications of this versatile, dependable material. We will be glad to send you a copy. Just write.

A. M. Byers Co., Pittsburgh, Pa. Established 1864. Boston, New York, Philadelphia, Washington, Atlanta, Chicago, St. Louis, Houston, Salt Lake City, Seattle, San Francisco.

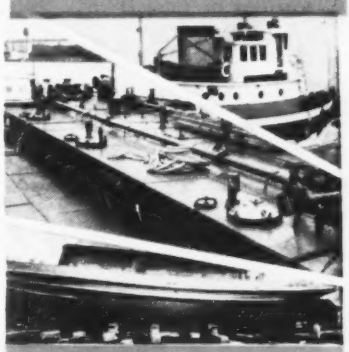


PIPING OR TANKS

RADIANT HEATING, SNOW MELTING, OR SKATING RINKS



TREATMENT OF SEWAGE OR WASTE



MARINE CONSTRUCTION, HULLS, PIPING AND STACKS

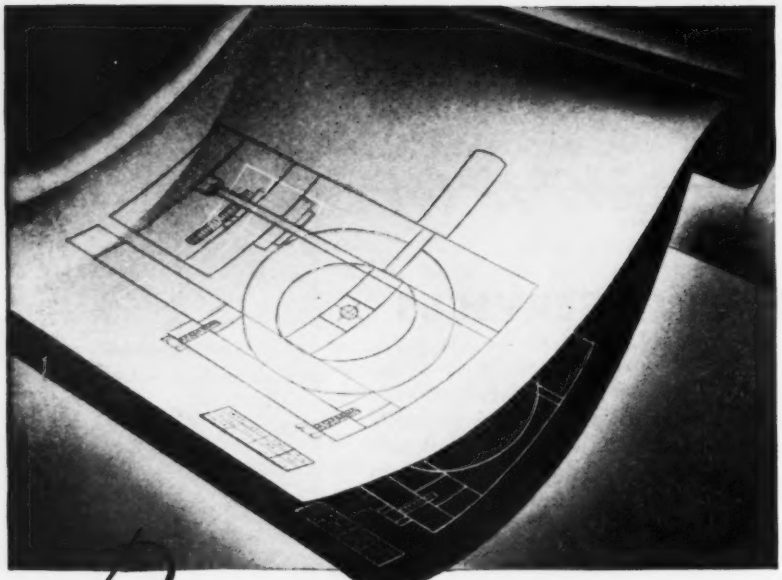
Corrosion costs you more than wrought iron

BYERS

GENUINE WROUGHT IRON

TUBULAR AND HOT ROLLED PRODUCTS

ELECTRIC FURNACE QUALITY ALLOY AND STAINLESS STEEL PRODUCTS



Prints as sharp as the original lines

Their faultless light transmission is one reason Arkwright Tracing Cloths are now *preferred* in thousands of blue print rooms from coast to coast. Arkwright has never depended on surface oils to provide the perfect translucency that can only be built into a tracing cloth by special mechanical processing.

That's why prints from Arkwright Tracings are just as sharp as the original drawing . . . no ghosts, distortions or false centers, caused by thin places, specks and pinholes.

And an Arkwright Tracing is a *permanent* tracing, because with mechanical processing, tracings never discolor or grow brittle. Months and even years later, prints are just as clean as when the tracing first left the board.

Why don't you see for yourself what a difference there is? Send for free working samples. Try them. Write to Arkwright Finishing Company, Providence, R. I.

★

Sold by leading drawing material dealers everywhere

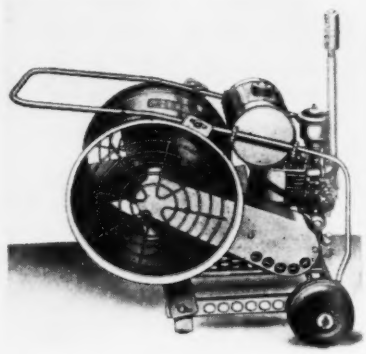
★

Arkwright

TRACING CLOTHS

AMERICA'S STANDARD FOR OVER 25 YEARS

50-250 deg. F.—*Fenwal, Inc., Ashland, Mass.*



PORTABLE VENTILATOR—A high-capacity, light weight, portable ventilator consists of a high-capacity fan powered by either a gasoline engine or an electric motor, mounted on a light weight metal frame equipped with two rubber-tired wheels. Standard equipment includes one 14 in. x 166 ft. length extensible canvas duct for conveying air to desired point. Two-way air flow permits drawing smoke, dust or gases from area or supplying fresh, cooling air to spot desired. Duct is specially treated for flame and moisture resistance. Maximum air delivery without duct is 4,500 cfm, and with duct, 4,000 cfm.—*The Herman Nelson Corp., Moline, Ill.*

PLASTIC COATING — A new plastic coating called Plastiglaze is impervious to water, salt air and water, and most mild acid solutions. It hardens, toughens and preserves paper, plywood, common lumber, and plaster. Where necessary it affords a high glaze to a surface. It has been used most effectively to coat plywood used as concrete forms, preventing adherence to the wood.—*Calresin Corp., Culvert City, Calif.*

RUNWAY AND STRIP MARKER LIGHTS—New AGA elevated runway and strip marker lights are designed to

HYATT PERFORMANCE HELPS PRODUCTION

This has been going on for over fifty-five years

Wheels, shafts and gears turn smoother and longer, free from friction and with less bearing care and wear when equipped with Hyatt Roller Bearings.

Everywhere in all applications they do their part to keep things moving constantly.

Over fifty-five years of dependable performance is proof of Hyatt correct design and precision manufacture.

And in the Hyatt line there are types and sizes to meet an endless variety of applications, with an Engineering Staff to help you anytime. Hyatt Bearings Division, General Motors Corporation, Harrison, New Jersey.

HYATT ROLLER BEARINGS

Worthington-Ransome Blue Brute Distributors

See ad on page 125 for list of equipment in each line

Worthington-Ransome Distributors

Alaska, Anchorage, Airport Mach. & Storage Co.
Ariz., Phoenix, Lee Redman Equipment Co.
Ark., Fort Smith, R. A. Young & Son
Little Rock, R. A. Young & Son

Calif., Richmond, Bay Equip. Co.
Cal., L. A. Golden State Equip. Co.
Colo., Denver, Mountain Region Supply Co.
Colo., Denver, Power Equipment Co.
Conn., Wallingford, Wilhelm-Davies Co., Inc.

Fla., Gainsville, Constr. Equip. & Supply Co., Inc.
Miami, Allied Equip. Inc.
Orlando, Highway Equipment and Supply Co.
Tampa, Epperson & Company

Ga., Atlanta, Tractor & Machinery Company

Ida., Boise, Olson Manufacturing Co.
Ill., Chicago, Chicago Construction Equip. Co.
Ill., Chicago, Thomas Hoist Co.
Ill., Chicago, J. A. Roche
Iowa, Cedar Rapids, McNall Mach. & Supply Corp.

Kansas, Topeka, M. B. Salisbury Co.
Ky., Harlan, Croushorn Equip. & Supply Co.
Louisville, Williams Tractor Co.

Maine, Portland, N. A. Burkitt, Inc.
Mich., Muskegon, Lakeshore Machy. & Supply Co.
Mich., Detroit, W. H. Anderson Co., Inc.
Minn., Minneapolis, Phillippi Murphy Equip. Co.
Mass., Cambridge, Field Machy. Co.
Mass., West Springfield, E. F. Edson Co., Inc.
Miss., Jackson, Jackson Road Equip. Co.
Md., Baltimore, Paving Supply & Equip. Co.
Md., Salisbury, Paving Supply & Equip. Co.
Mo., Clayton, The Howard Corporation
Mo., Kansas City, Machinery & Supplies Co.
St. Louis, W. H. Reaves
Montana, Billings, Interstate Truck & Equip. Co.
Helena, Caird Eng. Works
Montana, Missoula, Miller Machinery Co.

Nevada, Elko, C. W. Paul Hardware and Machy. Co.
N. Hampshire, Manchester, R. C. Hazelton Co., Inc.
N. J., No. Bergen, American Air Comp. Corp.
N. M., Albuquerque, Bud Fisher Co.
Roswell, Smith Machy. Co.
N. Y., Albany, Milton-Hale Machinery Co.
New York, Hodge & Hammond, Inc.
New York, Railroad Materials Corp.
Syracuse, Milton-Hale Mach. Co.
N. C., High Point, Smith Equip. Co.
N. D., Fargo, Smith Commercial Body Works, Inc.

Ohio, Cincinnati, Carroll-Edwards & Co.
Dayton, Carroll-Edwards & Co.
Toledo, The Kilcorse Machy. Co.
Okla., Oklahoma City, Tattan-Douglass Equip. Co.
Oregon, Portland, Andrews Machinery

Pa., Wilkes-Barre, Ensminger & Co.
Mechanisburg, American Equip. Corp.
Philadelphia, Metalweld, Inc.

S. C., Columbia, Smith Equipment Co.

Tenn., Chattanooga, Dempster Bros., Inc.
Tenn., Knoxville, Dempster Bros., Inc.
Memphis, Hamilton Tractor Co.
Nashville, Dempster Bros., Inc.
Tex., Amarillo, T. W. Carpenter Equip. Co.
Dallas, Shaw Equip. Co.
Houston, So. Texas Equip. Co., Inc.
San Antonio, Patten Machy. Co.
Tyler, D. M. McClure Equip. Co.

Utah, Salt Lake City, J. K. Wheeler Mach. Co.

Vt., Barre, A. M. Flanders, Inc.
Va., Richmond, Highway Machy. and Supply Co.

W. Va., South Charleston, Allied Equip. Co.
Wash., D. C., Paving Supply & Equip. Co.
Wash., Seattle Star Machy. Co.
Wisc., Milwaukee, Drott Tractor Co., Inc.

Ransome Distributors

La., New Orleans, Ole K. Olson Co.

N. Y., Buffalo, Murray Equip. Co.
N. Y., Rochester, H O Equip. Co.
O., Cleveland, H. B. Fuller Equip. Co.
Pa., Pittsburgh, Arrow Supply Company.

Worthington Distributors

Ind., Indianapolis, Reid-Holcomb Company

La., New Orleans, Wm. F. Surgi Equip. Co.

Md., Baltimore, D. C. Elphinstone, Inc.
Flint, Grandsen-Hall & Co.

N. Y., Buffalo, Dow & Co., Inc.
New York, Air Compressor Rental and Sales

O., Cleveland, Gibson-Stewart Co.
Toledo, The Kilcorse Mach. Co.

Pa., Allentown, H. N. Crowder, Jr., Inc.
Pittsburgh, Atlas Equip. Corp.

Texas, El Paso, Equip. Supply Co.

Wyoming, Cheyenne, Wilson Equip. & Supply Co.

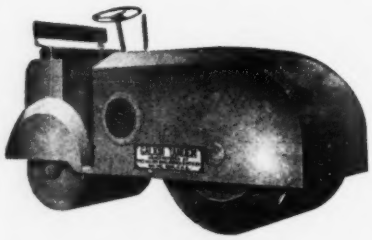
BUY BLUE BRUTES

Worthington Pump and Machinery Corp

Worthington-Ransome Construction Equipment Division

Holyoke, Massachusetts

meet the latest CAA specifications L-802 for the conversion of semi-flush contact lights. The new raised marker lights provide greatly increased visibility over the conventional semi-flush lights. These medium intensity elevated runway strip and taxiway marker lights are also useful for new installations on non-instrument runways at major air terminals as well as for taxiways. Lights are distributed by the *General Electric Co., Schenectady, N. Y.* Manufacturer, *American Gas Accumulator Co., 1029 Newark Ave., Elizabeth, N. J.*

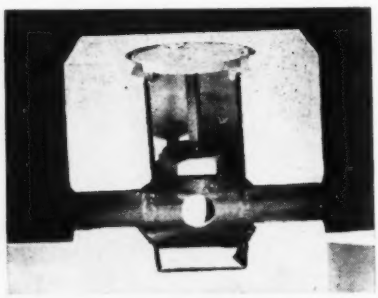


TANDEM ROLLER—New 3-to-5-ton roller is of variable weight design and is said to have metal weight of 7,120 lb. with ballasted weight being 10,520 lb. Fully ballasted, compression under main roll is listed as 170 lb. per inch of roll width and 85 lb. under steering roll. Main compression roll is large diameter. Both rolls are fitted with front and rear scrapers and mats. A 50-gal. water tank, for sprinkling both rolls, is provided.—*Galion Iron Works & Mfg. Co., Galion, Ohio.*

BOWL REFRACTORS—A new Holophone prismatic globe, the largest bowl refractor ever produced, combined with G-E's Form 79 and Form 101 casings and reflectors, will place as much as 43 percent more light on the street than the best reflector-type luminaire now available. It will be particularly applicable to freeways, urban highways, boulevards, main traffic arteries, and secondary business streets. The prismatic globe will accommodate 10,000- or 15,000-lumen filament lamps or a 16,000-lumen mercury lamp, and provides the best means for application of the vertical-burning mercury-vapor lamp. Light from the fixture emanates in two principal beams, up and down the street, in sufficient width to insure uniform distribution.—*General Electric Co., Lighting Division, Schenectady, N. Y.*

SELF-CLEANING SLUDGE TANKS—Two self-cleaning sludge tanks accomplish self-cleaning by pipe conveyors having synthetic rubber flights mounted on sealed pin chains. These pipe conveyors will operate in any plane. A radical departure from ordinary tanks is the double "V" bottom which permits rapid sludge settling and quick removal. A series of five baffles retards the coolant flow uniformly over the tank area. Power required to operate conveyors is small, 1/6 hp. for the junior size and 1/3 hp. motor for the standard size sludge tank. Temperature is limited to 270 deg. F. The junior size has a coolant capacity of 400 gal., while the standard size capacity is 3,200 gal.—*Hapman Conveyors, Inc., Detroit 21, Mich.*

EARTHMOVING EQUIPMENT—New 35-ton-capacity Model B Tournapull, powered by 225-hp. diesel engine, is available for use with two sizes of scrapers—E-35 Carryall, having 35-ton (26.1-yd., struck) capacity, or 25-ton E-25 Carryall (16.5-yd., struck) capacity. Unit has four speeds forward, two in reverse and travels up to 15 mph. New developments in its design include electric control, Tournamatic constant-mesh transmission and Tournamatic differential. Overall specifications of B Tournapull with E-35 Carryall are: Length 37½ ft.; height 11 ft. 3 in.; width 11 ft. 7 in.; wheelbase 23 ft. 8½ in.; minimum turning radius 33 ft.; and empty weight 20¼ tons. Unit can make 90-deg. turn in either direction.—*R. G. LeTourneau, Inc., Peoria, Ill.*



VALVE AND AIRVENT—A combination balancing valve and air vent for radiant heating installations is called, "Radiantrol." Its use is expected to reduce materially installation cost of radiant heating systems because additional piping, fittings and welding required for air vents are eliminated. The valve is somewhat similar to a butterfly type control valve. It can be used with

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Every time a WJ55 Blue Brute Hand-Held Rock Drill bites into rock . . . it makes a big dent in operating costs, too.

That's because Blue Brute Rock Drills give close bidders the kind of performance that means quicker, cleaner, deeper drilling for longer periods with less punishment to the runner.

And this 55-pound rock eater needs no babying because it's tough-muscled at such key places as — its positive-acting, end-seating valve, its rugged chuck housing and its smooth-operating rifle-bar construction.

Furthermore, this top-notch performance is doubly sure when you team up WJ55's with a Worthington Blue Brute Compressor. This portable power-house gets its punch from light, tight, efficient Feather* Valves, rigid alignment through 3-point engine and compressor suspension, full force-feed lubrication and other features. Comes with Diesel or gasoline drive.

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H7-9

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BLUE BRUTES

Your Blue Brute Distributor will be glad to show you how Worthington-Ransome construction equipment will put your jobs on a profitable basis. His name is listed on Page 124.

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Pavers, Portable and Stationary Mixers, Truck Mixers, Pneumatic Placing and Grouting Equipment and Accessories.

WORTHINGTON EQUIPMENT

Gasoline and Diesel Driven Portable Compressors, Rock Drills, Air Tools, Self-Priming Centrifugal Pumps and Accessories.

WORTHINGTON

Worthington Pump and Machinery Corporation, Worthington-Ransome Construction Equipment Division, Holyoke, Mass.

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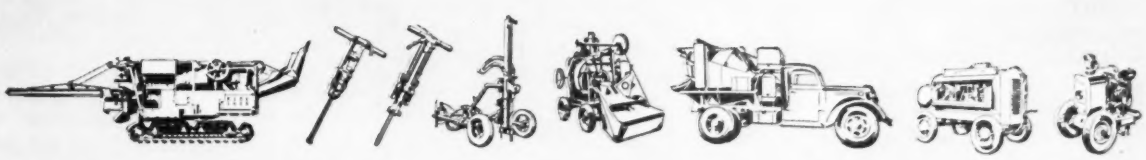

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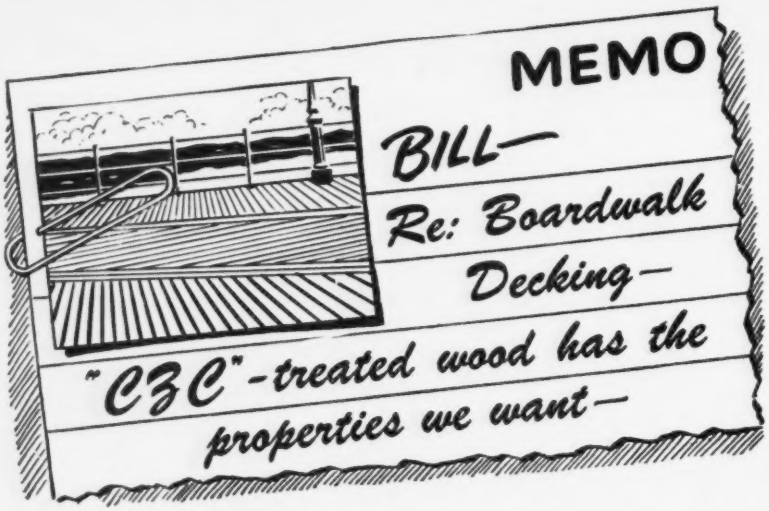

RESISTS DECAY: Boardwalk decking, caps and stringers are highly susceptible to decay—but wood that has been treated with Du Pont Chromated Zinc Chloride resists this costly damage—repairs and replacements are reduced wherever "CZC"-treated wood is used.

RETARDS FIRE: No chance for matches and cigarettes to cause fire in boardwalk decking built with "CZC"-treated wood. "CZC" gives wood greater protection against fire.

IMPROVES SAFETY: No danger of decking giving way because of decay, termites, or fire. "CZC"-treated wood resists these destructive forces—stays in better condition for a longer time.

Find out how "CZC"-treated wood can give your boardwalk deckings additional life. Write today for more detailed information. E. I. du Pont de Nemours & Co. (Inc.), Grasselli Chemicals Dept., Wilmington 98, Del.

DU PONT CZC

Chromated Zinc Chloride

MAKES WOOD RESIST DECAY • REPEL TERMITES • RETARD FIRE

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GROUT HOLES

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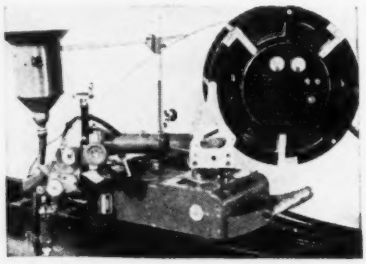
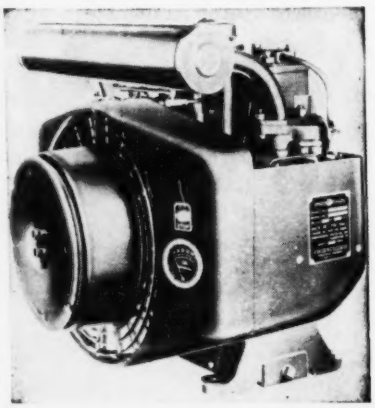
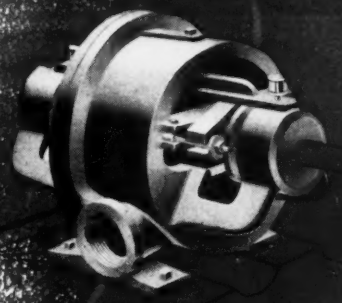
pipe coils buried as deep as 8 in. below the concrete surface because the hollow brass control stem can be cut to appropriate size. Valves in the 1¼ in. size which is adaptable to both 1 and 1¼ in. pipe are available. Additional sizes will be added later as the demand warrants. The fiber container in which the valve is shipped is designed to be used as a concrete pouring form.—*Homestead Valve Manufacturing Co., Inc., Coraopolis, Pa.*



PORTABLE WELDING MACHINE—Built specially for welding light-gage sheet and light plate by Unionmelt process, DS-37 welding machine is small and weighs only 190 lb. Unionmelt process is that of welding electrically beneath layer of granulated mineral composition without visible arc. Machine will butt-weld, in single pass, material from 16 gage to ¾ in. thick. It will also make, in single pass, positioned fillet welds with legs ⅛ to ¾ in.; non-positioned fillet welds with legs from ⅛ to ⅜ in.; and plug welds in materials ¼ to 1¼ in. thick. Welding currents up to 1,200 amp. can be applied.—*Linde Air Products Co., 30 E. 42nd St., New York 17, N. Y.*



LIGHTWEIGHT ENGINE—Twin-cylinder aluminum engine is available in two sizes. Small engine weighs 72 lb., fits into space 14x17x17, and has 3.1 to 6.7 hp. range, while larger unit weighs 98 lb. and has range from 6.5 to 10.1 hp. Either size can be equipped



Famous Westco Turbine-Type Pumps with renewable liners for high-head, low-speed service.

Fairbanks-Morse-Pomona Vertical Turbine Pumps: Open or closed impellers; oil or water lubricated.

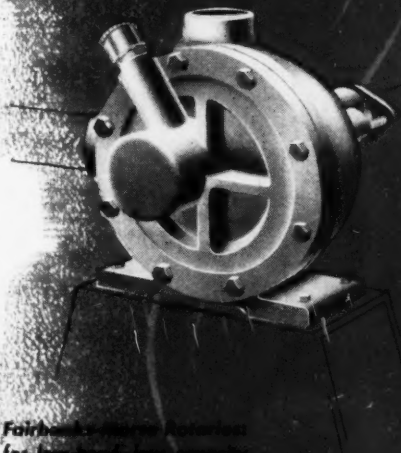
Can ANYONE sell a pump?

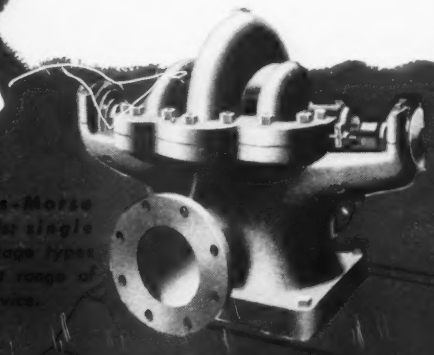
No, just anyone can't sell a pump—properly.

It takes a lot of adroit engineering to figure the right pump for any specific job. It takes a broad background of experience to enable a man to be sure he's selling you a pump that will make you a long-term friend and customer.

This engineering ability and experience are yours when you buy from a Fairbanks-Morse-Pomona dealer.

He *knows* pumps. He has the broadest line to choose from; he's backed by all the engineering and production resources of Fairbanks-Morse. He can offer you skilled, impartial advice—he can sell you the pumping savings and satisfaction you're after.





Fairbanks-Morse Centrifugals: single and multi-stage types for broadest range of pumping service.

Fairbanks-Morse Rotaries for low-head, low-capacity work at all industries.

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DIESEL LOCOMOTIVES • DIESEL ENGINES

KINNEY
BITUMINOUS DISTRIBUTORS
ENGINEERED TO AVOID WASTE —SAVE MONEY

The Kinney Distributor is an extremely economical and profitable machine. A simple three-way valve controls loading, circulating and spraying — provides instant starting. The large handwheel controls wide lateral movement of spray bar for exact register at road edges or successive strips. The high capacity Kinney Rotating Plunger Pump is accurate as a meter and applies all grades of bitumen uniformly in exact quantity specified. The Kinney Distributor shown is applying a surface treatment at exactly 0.5 gal. per sq. yd. — note the uniform application and close matching of strips.

Write for Bulletin.

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We also manufacture Vacuum Pumps, Liquid Pumps and Clutches.

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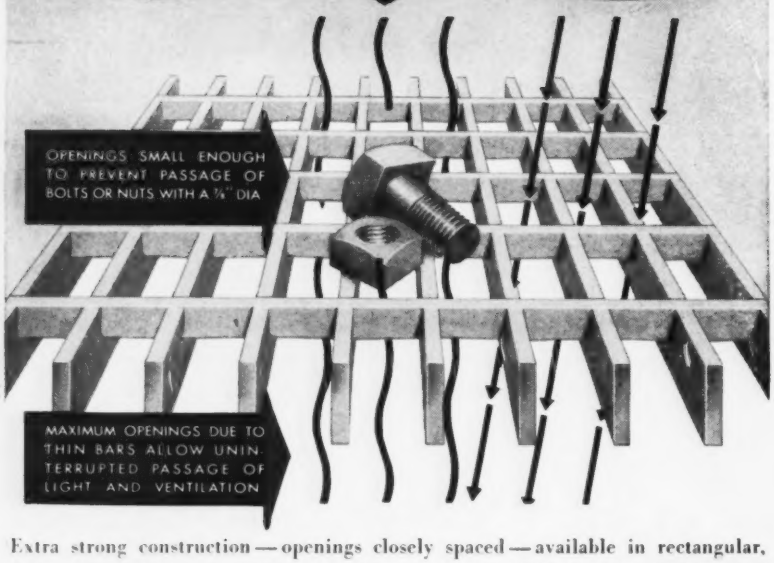
OPEN STEEL FLOORING


OPENINGS SMALL ENOUGH TO PREVENT PASSAGE OF BOLTS OR NUTS WITH A ⅞" DIA
MAXIMUM OPENINGS DUE TO THIN BARS ALLOW UNINTERRUPTED PASSAGE OF LIGHT AND VENTILATION

Extra strong construction — openings closely spaced — available in rectangular, diagonal and U shapes — with Safety Steps. Ask for Bulletin 1140.

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(Distributor for THE TRI-LOK COMPANY)

DRAVO

with specially designed starter-generator.—*Fairbanks, Morse & Co., 600 S. Michigan Ave., Chicago 5, Ill.*

BOARD ALIGNER—New tool, known as Bord-Jak, is designed for quick application of flooring, siding and sheathing with tightest possible joints. Even badly warped boards can be forced into line and held in position for easy and accurate nailing. Quick tap of hammer against anchor head sets it into position on joists and lever action against broad pressure plates squeezes boards tightly together and holds them in position. Spreading or squeezing joists or studs that bow too closely together can be accomplished by using accessory feet which are a part of each tool.—*Maco Corp., Huntington, Ind.*

WOOD BORING TOOLS—Circo E-Z-Out boring tool and the Circo E-Z-Out combination boring and counter boring tool, feature high speed tool steel cutting blades that have no teeth to break off. Both tools also eliminate the hazard of heavy, flying chips. Both tools can be used with a standard electric or air-power drill for any heavy industrial wood-boring operation. Each consists of a specially designed pilot drill and four high speed tool steel cutting blades with extra thickness for extra strength. The tapered cutting edges remain sharp longer and are easily and quickly resharpened without special tools.—*Circo Tool Co., Milwaukee, Wis.*

CARBIDE TIPPED MASONRY DRILLS—Handy kits contain five of most popular size drills and boxed sets

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Type RH, heat-resistant, rubber-insulated building wire, in sizes 6 Awg through 1000 MCM, can be supplied with aluminum conductors.

These days — when you have such a wide range of building wires and cables to choose from — you may need a helping hand to make the right choice every time. Of course, your selection of the General Electric name on the wires you use is always a wise one. But we'd like to go all the way with you. We'd like to help you make sure your choice is right for the specific job you've got to do. That's why we invite you to take your problems to your General Electric merchandise distributor, or to submit them directly to us.

In General Electric's full range of wires and cables, there is a specific type for every job — a type that's best suited to your particular needs. The line includes code grade, heat-resistant and moisture-resistant rubber-insulated and braided building wires . . . and moisture-resistant thermoplastic-insulated building wires . . . lead sheathed building wires . . . service entrance cables . . . nonmetallic sheathed cables with rubber- or thermoplastic-insulated conductors . . . BX* armored cable.

As wiring problems come up, let your General Electric merchandise distributor help you choose the right wire and cable, or write for further information to Section W73-1034, General Electric Company, Bridgeport 2, Conn.

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Below-grade waterproofing and above-grade dampproofing affect the total cost of a structure very slightly. Yet, these treatments included in your specifications have a tremendous effect on the permanence and maintenance of a building. Properly executed, both waterproofing and dampproofing will add many years of profitable life to any type structure, reduce the exterior and interior maintenance costs, and help to assure a decorative, weather-resistant facade.

You can place the responsibility for a dry building where it properly belongs — on a reputable waterproofing contractor. Western's 35 years of experience in the solution of weatherproofing problems for America's leading firms can be successfully applied to the protection and maintenance projects of your clients. The nearest Western office will gladly assist in furnishing full information on how to specify Western methods, equipment, technical skill, and exclusive materials. Specify Western and establish definite responsibility for watertight buildings.

Weatherproofing — the art of preserving buildings through an intelligent understanding of natural forces and the use of proper materials.

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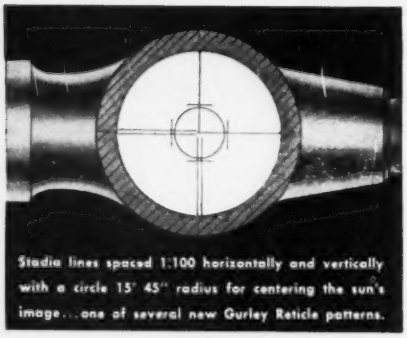

Stadia lines spaced 1:100 horizontally and vertically with a circle 15' 45" radius for centering the sun's image...one of several new Gurley Reticle patterns.

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contain eight. Both are available with drills having either round or Super-grip hex-type shanks of improved slip-proof design. Also included with each kit and set is new chart indicating proper side drill to use in drilling masonry for all types of expansive screws, bolts, bolt shields, anchors, etc.—*Super Tool Co., 21650 Hoover Rd., Detroit 13, Mich.*

HALF-TRACK UNIT—New Model D-15 incorporates full contour traction for maximum engaged track area and increased stability, new long traction unit for greater load capacity and track area, and higher speeds. It is either gasoline or diesel powered.—*Linn Mfg. Corp., 250 W. 57th St., New York 19, N. Y.*

SIX-WHEEL TRUCKS AND TRACTORS—Model LTSW, in truck or tractor types, for express highway service, can handle huge loads either alone or in combination with semi- or full-trailers. Model LTSW-L is modified to meet demands of off-highway duty for logging and similar operations. Standard power source is EN 707A engine, latest of Thermodyne series. Transmission is TRD 15 Duplex, affording ten forward speeds. Mack exclusive, heavy-duty balanced bogie eliminates wheel-bight, tire-scuffing and consequent power loss. Mack power divider serves as third or inter-axle differential. Dual reduction axles employ Tetrapoid spur gear design for reduction and Orthopoid bevel pinion gears for change of direction.—*Mack Trucks, Inc., Empire State Bldg., New York, N. Y.*

FIRE EXTINGUISHER—The splash-proof Foamite Firefoam, for vehicle service, has a sealed stopper construction built into the top which prevents the chemicals from mixing until needed. It produces a fire-killing chemical foam equal to approximately 10 times its own capacity and stops oil and gasoline fires and prevents reflashing. It has mono-

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Elevated Steel

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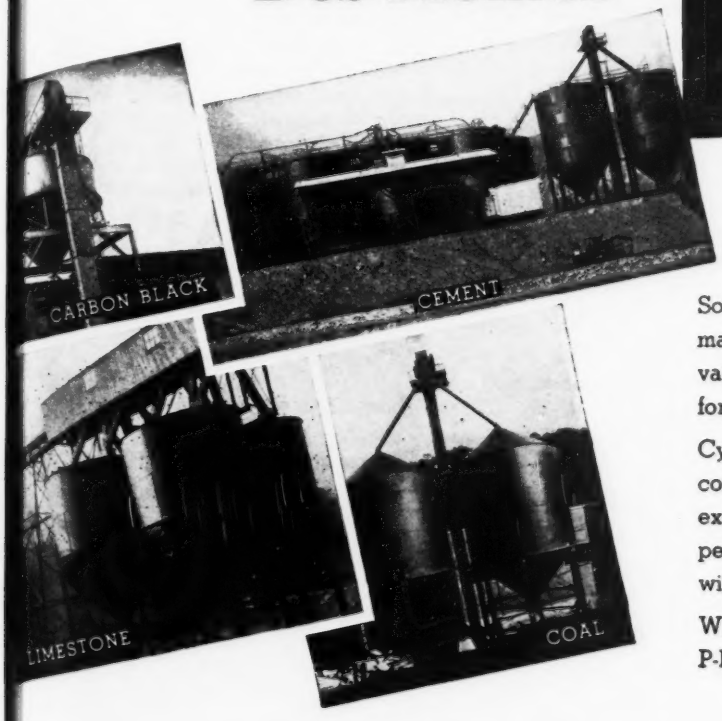
by Pittsburgh-Des Moines

200-ton capacity carbon black storage bin recently erected for Firestone Tire and Rubber Co. Cone bottom and roof; shell 30′ x 21′6″; eight columns, 35′10″ high to belt.



Sound design and expert craftsmanship deliver maximum values in Pittsburgh-Des Moines Elevated Steel Bins—engineered in a variety of types for the storage of all free-flowing dry materials.

Cylindrical bins are furnished with conical or conispherical bottoms, and require no stiffening except at belt seam. Square, rectangular or suspended types are supplied to meet special needs, with stiffened or stayed sides and bottoms.

Whatever your bin requirements, you'll profit by a P-DM consultation! Write, without obligation.

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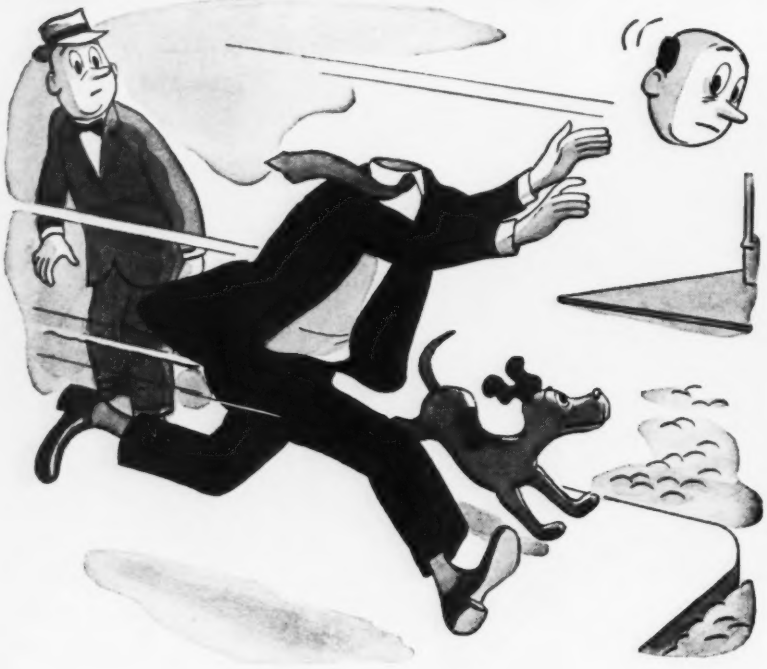
SEATTLE, 522 FIRST AVENUE, SOUTH

Don't lose your head over shortages!



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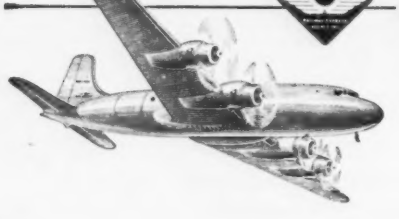
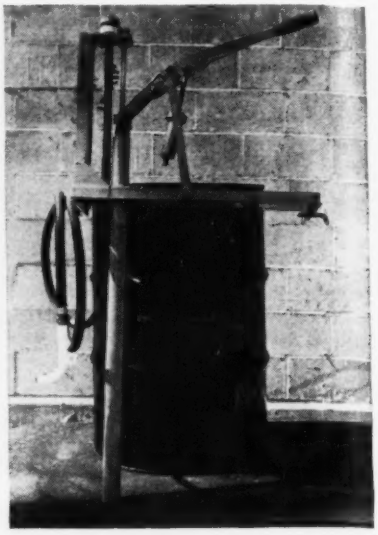


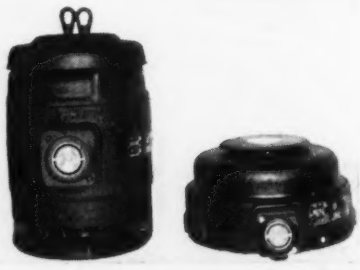
Fastest delivery—at low rates

Refrigerator parts (**120** lbs.) in Detroit were needed in West Palm Beach *fast*. Picked up 4:20 PM the 16th, delivered 10 AM on 17th. **1135** miles, Air Express charge only **$40.52**. Other rates, any distance, similarly inexpensive and *fast*.

type seamless drawn shell construction and is tested to 550 psi. With a stream range from 35 to 40 ft., the foam can reach fires beneath the truck body as well as all other surfaces.—*American La-France-Foamite Corp., Elmira, N. Y.*



AIR-ENTRAINING DISPENSER—Adding Darex AEA to concrete at the mixer is made easy with the DP-12 Darex AEA Dispenser which is fast and accurate when used on any type of mixer in ready-mix, block or products plant or job-site concrete mixing. Easily installed on an up-ended drum, ready for use in a couple of minutes, it may be moved from job to job. Sturdily constructed to take hard use, it is precision built for accuracy.—*The Charles R. Watts & Co., Seattle, Wash.*



AXIAL AIR-GAP ELECTRIC MOTOR—An entirely new type of electric motor designated as Axial Air-Gap is a radical departure in design of electric motors. It is distinguished by the fact that the magnetic lines of force follow a path parallel to the shaft (or axis of rotation) as compared to a radial path taken by the magnetic flux in the so-called conventional motor. This new line of motors, ranging in size from ⅓ to 10 hp., is suitable for horizontal or vertical

Concrete Joist Construction?

Because Today's Costs are NOT Out of Line . . . Because, strength and durability considered, concrete joist construction is the most economical way to build . . .

In these days of high costs, economy in building is important, provided strength and durability are not sacrificed. Here is where concrete joist construction comes in—since it provides rigid, strong, sound-proof buildings which are fire resistive, yet construction cost is lower. That is because the amount of concrete and, consequently, the dead load, are kept to a minimum for any span or live load. The concrete joist and monolithic top slab are formed with cores of removable Meyer steelforms, supported on skeleton centering. Once the concrete has set, the forms are removed and re-used from floor to floor and from job to job. Therefore, a nominal rental charge can be made for each use. Construction is speeded up.

WHY SPECIFY CECO?

Ceco originated the removable steelform method of concrete joist construction. The company is first in the field—actually providing more services than all competitors combined. So, when concrete joist construction fits your need, call on Ceco, the leader over all. Thirty five years of experience in the field, on the job, have given Ceco a sure grasp of all concrete joist construction problems. This fund of knowledge is yours to command, in 23 strategically located offices from coast to coast.

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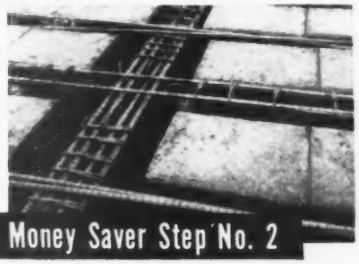
4 STEPS TO REDUCE BUILDING COSTS...

Money Saver Step No. 1

Meyer steelforms completely erected on open wood centering, ready for placement of reinforcing steel and concrete. Note column spirals awaiting installation in columns. Ceco engineers lay out and supervise the complete installation of steelforms on open wood centering.

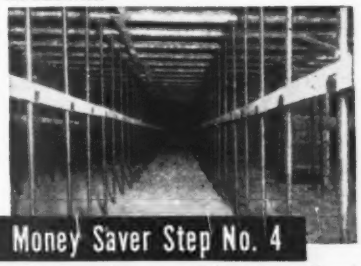


Money Saver Step No. 2

In this photograph, the reinforcing bars are installed as detailed by Ceco, in proper relation to the erected steelforms. Now the job is ready for placement of the temperature mesh in the top slab. This mesh reinforcement is also supplied by Ceco.

Money Saver Step No. 3

Here the mesh, also known as welded wire fabric, has been placed in correct position and the pouring of concrete for the top slab has commenced. In Ceco-erected jobs such as this, the design is carefully engineered to assure proper reinforcement throughout the structure.



Money Saver Step No. 4

Underneath the concrete joists, Meyer adjustable steel shores support the open wood centering. Forming the floor construction above are adjustable-type steelforms nailed to the centering. Also available are flange-type steelforms, used when plastered ceilings are to be installed.

Partial list of other Ceco Products:
STEEL JOISTS AND ROOF DECK
METAL WINDOWS AND DOORS
METAL FRAME SCREENS • ALUMINUM STORM PANELS • METAL LATH AND ACCESSORIES • HIGHWAY PRODUCTS
CORRUGATED ROOFING • LOUVRE VENTILATORS

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Knocks the Socks off PAVING COSTS!

This revolutionary new development in Municipal Paving Units has definitely proved that it can place perfectly upwards of 65 cubic yards of concrete in a single hour!

FURTHERMORE, IT EMPLOYS THE ONLY SCREED THAT WILL:

1. Undercut at side forms,
2. Roll back for second pass.
3. Strike-off crowns, both regular and inverted.
4. Permit operators to work from front, rear or sides.

In addition, the screed has such a strong tendency to propel itself in the forward direction that only small effort is necessary to strike-off stiff mixes of concrete. Manholes and storm sewers are no handicap due to the fact the screed does not reciprocate. Does an excellent job of vibrating concrete in slab depths up to 10 inches. Can be used to great advantage on any slab width from 6' on up to any practicable width. For radically reduced costs and far greater production, by all means write for complete details of this remarkable paving unit RIGHT NOW!

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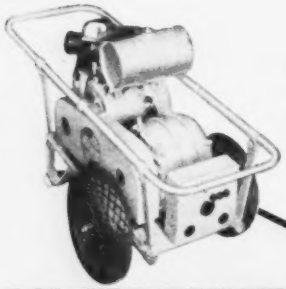
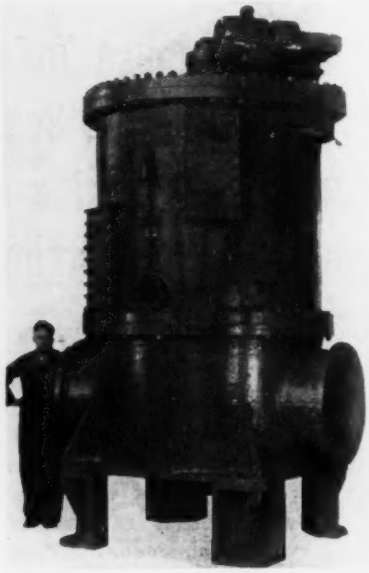


MODEL M-1 POWER PLANT

furnished with Model SC200 Screed. Capacity: 1.25 K.V.A. Generates both single phase and 3-phase 110 Volt 60 Cycle AC. Also ideal for operating lights, vibrators and powers tools.

ELECTRIC TAMPER & EQUIPMENT CO.
LUDINGTON MICHIGAN

flange mounting, or on an angle base for belt drive. The new motor is less than half the size of the conventional type motor and weighs less by approximately 30 percent.—*Fairbanks, Morse & Co., Chicago, Ill.*



SELF-CLEANING WATER STRAINER—A practical and proven type of strainer is finding broad application in the treatment of certain types of water supplies, particularly when the load from suspended matter is heavy. Known as the Brassert self-cleaning water strainer, the device consists essentially of a slowly revolving conical drum, which is retained in a heavy housing. The drum may be equipped with numerous types of removable straining media, either of porcelain strainers, stainless steel screens or bronze slotted cones. According to the size of the strainer, the housing is equipped with one or two backwash ports. The strainers are built in sizes ranging from 3 to 30 in. pipe size, equipped with a gearhead motor requiring ½ to 5 hp. for operation.—*S. P. Kinney Engineers, Inc., 233 Oliver Ave., Pittsburgh, Pa.*

AUTOMATIC CLUTCH—Mercury-actuated clutch makes possible automatic starting of air compressors. It permits driving motor to attain full speed before compressor turns, eliminating need for pressure release valves. Mercury is used as control medium because of its high specific gravity. Centrifugal force produces hydraulic pressure which is utilized, without levers or other mechanical means, to cause engagement of friction elements of clutch.—*Mercury Clutch Corp., Canton 6, Ohio.*

Contractors say

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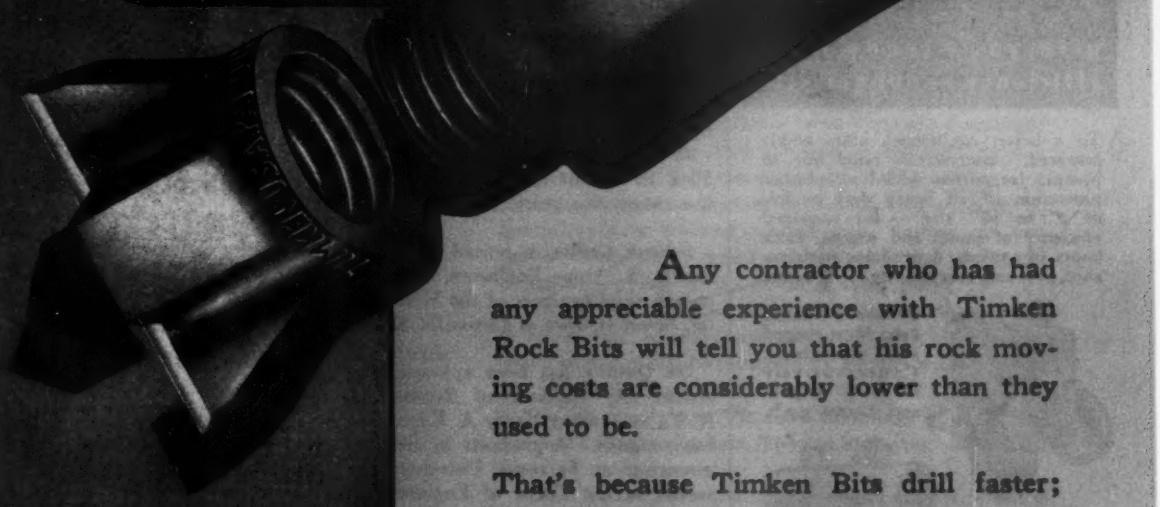

Any contractor who has had any appreciable experience with Timken Rock Bits will tell you that his rock moving costs are considerably lower than they used to be.

That's because Timken Bits drill faster; yield more footage per bit; can usually be reconditioned several times for additional service life; drastically cut steel costs; save the drillers' time.

These advantages spring from a combination of design, material and manufacturing technique that cannot be duplicated. No other bit manufacturer makes his own steel. No other bit manufacturer has the benefit of such far-reaching metallurgical knowledge and experience.

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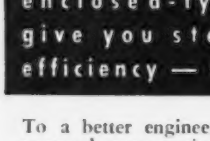
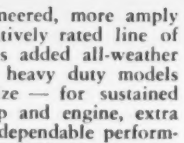
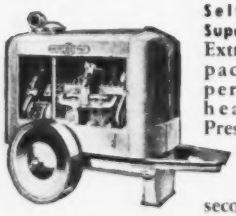
To a better engineered, more amply powered, conservatively rated line of pumps, Jaeger has added all-weather protection of all heavy duty models of 2" to 10" size — for sustained efficiency of pump and engine, extra hours of smooth, dependable performance, plus easy accessibility at all times.



2" and 3" Heavy Duty: Most rugged small pumps built. Conservatively rated @ 10,000 and 20,000 g.p.h.



4" to 10" Portables: Compact, extra powerful units of 40,000 to 240,000 g.p.h. rating and exceptional air capacity.



Self-Priming Super-Jet Pump: Extremely compact, yet outperforms old, heavy types. Pressures to 250 lbs.; 90 h.p. engine. Only 30 seconds to prime @ 20 ft.

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Inherent priming action plus "jet" priming — doubly sure and fast . . . long-life "Lubri-Seal," accessible for inspection . . . self-cleaning shell design . . . replaceable liners or seal rings . . . Every pump tested and certified for performance.

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Men and Jobs

Roy E. Larson, formerly chief estimator of James Stewart & Co., Inc., has rejoined the company as head of the departments of budgets and costs. In announcing Mr. Larson's appointment M. E. Kalette, president of the Stewart Company, said that because of the complexity and instability of current costs in the industrial construction field the company felt it desirable to strengthen the departments responsible for control of costs. Mr. Larson, a graduate of Brooklyn Polytechnic Institute, has been identified with the construction industry in New York in various capacities during the last twenty-five years.

Schenk Griffin, a retired colonel of the U. S. Army Engineers, has been chosen chief engineer of the Metropolitan Sewer District of Louisville, Ky.

Ira Quinby has been appointed assistant city engineer of Tonawanda, N. Y., succeeding Harey A. Kage, who has resigned. A graduate in civil engineering at Syracuse University, he served in the Corps of Engineers in World War II.

Col. Francis H. Falkner, former district U. S. Army Engineer at Huntington, W. Va., goes to Pittsburgh, Pa., to serve as assistant to the acting engineer, Col. Louis E. Foote.

Wesley B. Thompson, formerly a senior engineer with Fay, Spofford & Thorndike, Boston, Mass., has resigned to open a civil and structural engineering office at 7 Water Street in that city. Mr. Thompson entered the engineering field after serving with the Army in World War I. He was employed by steel fabricating firms; then by the New York Central and Rutland railroad systems in bridge, ferry terminal, grade crossing and rehabilitation work; served for a time with the U. S. Coast and Geodetic Survey and U. S. Army Engineers; and designed special structures and facilities with the American Steel & Wire Co. in connection with aerial tramways in the Americas and the Philippines. Later he was associated with Jackson & Moreland, and J. R. Worcester & Co. Boston consult-

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COVERS the how and why of foundation and substructure design and construction, the general theory of structural members, the detailed design of such members and the design of their connection with other members.

EXPLAINS the principles of statics, reactions moments and shears in beams and trusses, influence lines, methods of computing stresses in lateral trusses and portal bracing.

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ants, and did research work for the U. S. Navy. Bridge investigations in Connecticut and Virginia occupied him in his Boston connections, including the work of design engineer for Fay, Spofford & Thorndike on the Alaskan facilities for the Army. In World War II he handled a wide range of shipyard and dry dock engineering for the Navy, facilities for northern bases for the Army, and collaborated with the Scripps Institute of California while working for the Wood's Hole Oceanographic Institute on a naval project which was concerned with landing operations.

Two district engineers for the Washington State Highway Department have exchanged positions, with **George H. Shearer** moving from Seattle to Vancouver and **Walter F. Winters** from Vancouver to Seattle. Both are graduates of Washington State College; Shearer in 1912 and Winters in 1924. Shearer, after engaging in railroad engineering, joined the department in 1919 as a resident engineer, became Spokane district engineer in 1927 and assumed the Seattle post in 1929. Winters' first engineering job was as assistant to the Olympia city engineer, later becoming deputy Thurston County engineer and later county engineer in Whatcom and Douglas counties. After seven years in the Army, rising to the rank of colonel, he joined the highway department last year.

Carl A. Metz, structural engineer, **Alfred Shaw,** architect, and **John Dolio,** mechanical and electrical engineer, have formed a partnership, Shaw, Metz & Dolio, for the practice of architecture and engineering, with offices at 208 South LaSalle St. and 80 East Jackson Blvd., Chicago.

J. F. Bivens, who for the last five years has served as city engineer in Mt. Airy, N. C., has returned to the North Carolina Highways & Public Works Department as senior resident engineer in Stokes County.

E. A. Humphreys has been appointed division engineer of the Illinois division of the New York Central System with headquarters at Mattoon, Ill., vice C. V. Talley, transferred as division engineer of the Ohio division at Springfield, Ohio.

Louis C. McCabe, of Washington, D. C., has been named chief administrator of the new anti-smog district in Los Angeles county, Calif. He will go into office October 2 when the new state law on smog takes effect. Dr. McCabe, an ex-Army colonel, took

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"Before you install any piping system, remember this: to save money and man-hours...use Victaulic Couplings!
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"In Victaulic-coupled pipelines contraction-expansion is taken care of automatically... and any pipe length, valve or fitting can be removed for repairs without backing off adjoining sections.
"So — not only are Victaulic Couplings your answer for low-cost installations. They're also your answer for low-cost maintenance!
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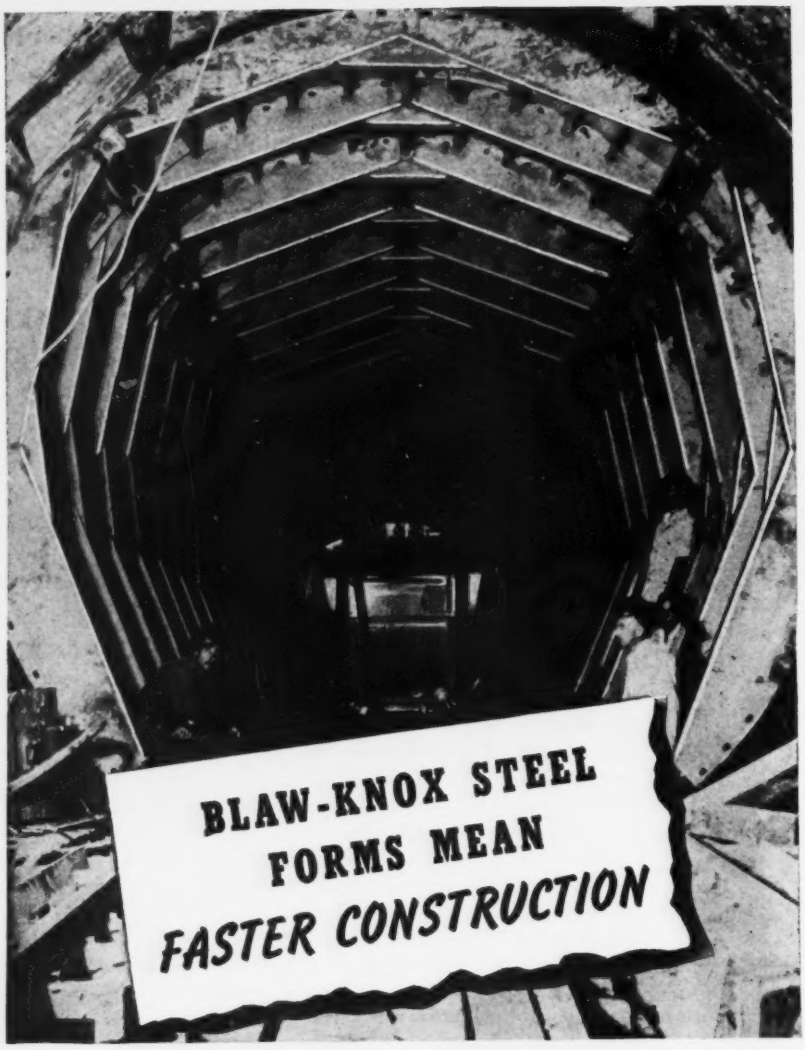

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Whether the job calls for heavy forms on tunnels and conduits, on low retaining walls or high multiple arch dams, Blaw-Knox forms assemble and strip readily, save time and manpower, and generally speed and improve the work.

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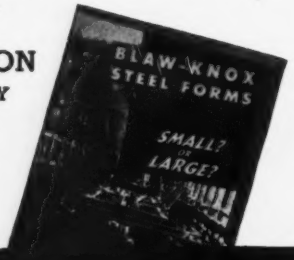

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STEEL FORMS

postgraduate work at the University of Illinois, and worked on smoke abatement problems in Chicago. During World War II he operated coal mines in Belgium and the Ruhr for the United States Army. He is at the present time Chief of the coal division of the U. S. Bureau of Mines.

Nealy Pope, connected with the North Carolina Highway Department for the last 12 years, has been named assistant superintendent of the municipal street department at Dunn, N. C.

J. D. Carpenter, vice-president of Gannett Fleming Corddry & Carpenter, Inc., of Harrisburg, Pa., and a part of four engineers from that firm have gone to Medellin, Colombia, where the Gannett organization is cooperating with the Frederick Share Corp. of New York in the design and construction of a new water supply for the city.

Commander Arthur J. Beckwith (Coast Guard, retired) has been appointed town engineer for Amherst, N. Y., to take over part of the increased work in the town engineer's office resulting from a residential construction boom.

Lt. Col. Walter W. McCoubrey, Lexington, Mass., has joined the engineering staff of the Boston Port Authority after a stretch of six years in the United States Army. Previously he had been connected with the old Boston Port Authority for 11 years.

Col. D. W. Griffiths, Galveston, Tex., district engineer for the last year, has been relieved of duty there to accept an important overseas post. **Col. B. L. Robinson,** who served as a brigadier general with the Engineers in the Pacific during World War II, replaced Colonel Griffiths who was a member of Gen. Eisenhower's staff overseas during the war.

Cornelius G. Ahearn, Jr., who has been in the employ of the Menominee, Mich. County highway department for more than 20 years and acting superintendent for the last 9 months, has been appointed superintendent to succeed the late E. J. Pearce.

Robert B. Richardson, 46, an employee of the Louisiana State Highway Department for the last 26 years, has been named acting director to succeed Col. P. A. Frye, who has been on leave from his permanent position as secretary and executive officer of the Louisiana Public Service Commission and will now return to that work. Mr. Rich-

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Faster drilling in any ground! The new Gardner-Denver URM Wagon Drill provides fast, powerful drilling in any kind of ground—hard and solid or soft and broken. Designed for 6-foot steel changes, the motor feed is operated by a powerful 5-cylinder radial air motor driving an endless chain attached to a heavy mounting slide carrying the drill. The URM carries a 3½″ or 4″ bore Gardner-Denver derrick drill and a 3-pint LO-11 Line Oiler.

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Quicker steel changes—Easier spotting! Drill steel support at top of mast assists in faster steel changing. Centralizer or hole spotter is held in place positively in both open and closed positions.

Wide flexibility! U-bar is adjustable from a position slightly above horizontal, through an arc of 90 degrees, to one practically vertical. Large wheels are adjustable to 90 degrees for line drilling.

Easily maneuverable! With its three pneumatic-tired wheels, the URM is easily moved over rough ground. The RM feed may be adjusted to any drilling position, vertical or horizontal. Adjustable mounting cone on mast allows rapid accommodation to suit ground condition.

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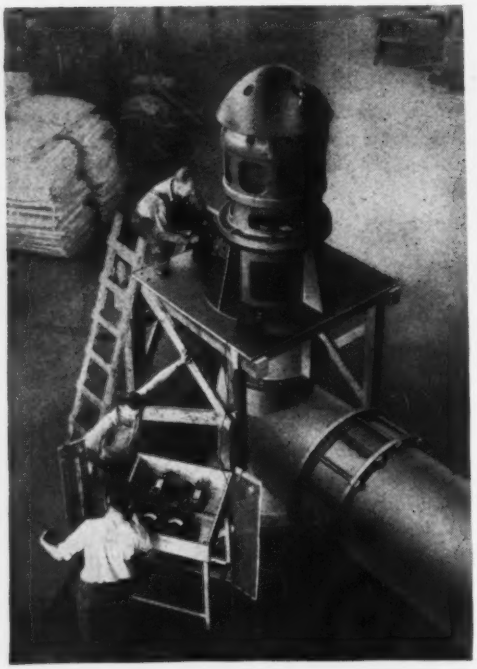

A 42-inch vertical unit receives final check-up prior to shipment.

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3-Ton "Junior" — Drum capacity: 150 ft. of ½" cable; wt. 75 lbs; **$60.**
3-Ton "Standard" — Drum capacity: 325 ft. of ½" cable; wt. 135 lbs; **$85.**
3-Ton "Heavy Duty" — Drum capacity: 325 ft. of ½" cable; wt. 140 lbs; **$90.**

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ardson has been with the department since September, 1921. His present position is that of construction and maintenance engineer.

Paul J. Prout, engineer in the Long Beach, Calif., department of building and safety, is resigning to open his own office as a consulting engineer. He was formerly a consultant to the U. S. Army Corps of Engineers, the Metropolitan Water District, Long Beach Harbor Department and several private firms. He attended the University of Southern California and Brigham Young University.

Stanley I. Pinel has rejoined the staff of Griffenhagen & Associates, consultants in management, after serving several years as director of public service, St. Petersburg, Fla. as chief engineer in the Detroit area of the Federal Public Housing Authority; and as director of research, American Public Works Association. Mr. Pinel was formerly a senior staff member with Griffenhagen & Associates. He now becomes principal engineer.

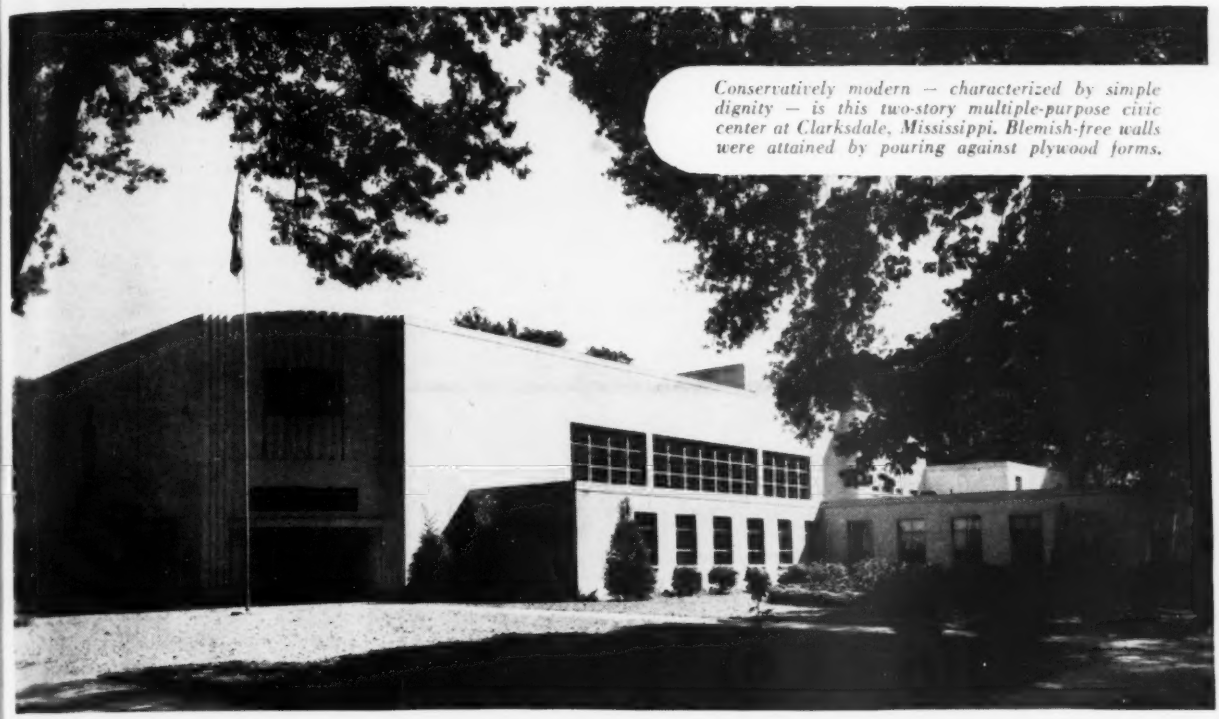
Griffenhagen & Associates have offices in Chicago, New York, Boston, Washington, and Cleveland.

P. A. Frye has resigned as director of highways in Louisiana and is succeeded by **Robert R. Richardson,** construction and maintenance engineer of the department since 1940. Mr. Frye will return to his duties as secretary and executive officer of the Louisiana Public Service Commission.

State Road Commissioner Ray Cavendish of West Virginia has picked **C. L. Hundley,** veteran highway engineer as his successor in the office of state maintenance engineer. Hundley has been with the commission since 1933 and served in several sections of the state as district engineer. He also has been assistant to the chief engineer. He leaves the post of District Six engineer at Moundsville, West Virginia.

C. L. Hundley

Col. Harry E. Blakely, after spending the last six months at the American Road Builders Association headquarters in Washington as a "refresher course" in organization work, has become executive secretary of the Mississippi Highway Contractor's Association, Jackson, Miss., an ARBA affiliate. After 56 months overseas with the



Conservatively modern — characterized by simple dignity — is this two-story multiple-purpose civic center at Clarksdale, Mississippi. Blemish-free walls were attained by pouring against plywood forms.

"In our monolithic concrete,"
says Architect E. L. Malvaney

"Best Results Are Obtained With Plywood Forms"

E. L. Malvaney, A.I.A., Jackson, Mississippi, designer of this attractive, modern civic center, relied on smooth, fin-free walls to help attain the building's pleasant appearance of simple dignity. Douglas fir plywood forms were used, and Mr. Malvaney echoes the experience of many architects and builders when he says, "In our monolithic concrete, we have found that best results are obtained through the use of plywood forms, without rubbing."

ECONOMY RESULTS FROM RE-USE OF PANELS

Plywood's cross-laminated construction gives it a high strength-weight ratio — an extra durability that makes possible the multiple re-use of panels. Plywood is light, easy to work and handle. Plywood's sanded panel faces result in smoother concrete surfaces; fins and joints are minimized and rubbing costs are materially reduced. Plywood has many advantages for concrete form work. Utilize them!

BELOW: *Another building designed by Mr. Malvaney—the Redwood Consolidated School, Warren County, Mississippi. Smooth concrete walls were formed against Douglas fir plywood.*

Plywood's Many Advantages Keep Demand Greater Than Present Supplies

Douglas fir plywood production is now greater than in prewar years. Today's demand, however, is unprecedented, and available raw material is the controlling factor in attaining greater output. The resulting uneven demand-supply ratio means that plywood may not always be available at any given time and place. For price and delivery information, see your regular source of supply. Technical data may be secured from the Douglas Fir Plywood Association, Tacoma 2, Washington.

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LARGE, LIGHT, STRONG

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Panels

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PIPELINES
INDUSTRIAL PLANTS

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Army, in the Washington office of ARBA, Col. Blakeley was acting managing-director of the Contractor's Division. He is an alumnus of Georgia Tech in civil engineering, 1938. He taught that subject for four years at the University of Tennessee. Later he worked on a number of important construction projects.

Col. John S. Seybold has reported to Fort Lincoln, N. C., to assume his duties as Garrison district engineer in charge of construction of the $160,000,000 Garrison Dam for the Army Corps of Engineers.

A. R. Garnock has been named by the city council of Eau Claire, Wis., to fill the newly created position of public works and planning engineer. Mr. Garnock's previous post as city engineer is being taken over by **Neil Bartholomew** who was his assistant for several years.

John H. Melvin, head of the Geology subsection, Omaha District Corps of Engineers, has been appointed state geologist of Ohio by George B. Sowers, Director of Public Works. Formerly treasurer and geologist for the Pennsylvania Drilling Co., Mr. Melvin has a wide background of experience in economic and engineering geology.

J. H. Melvin

Herbert K. Cook, concrete research engineer, was recently designated chief of the concrete research division of the Waterways Experiment Station, Vicksburg, Miss., replacing **Charles E. Wuerpel** who has gone with the Inter-American Construction Co. as the expert on concrete of the Comision Technica Norteamericana in Buenos Aires, Argentina. The commission is the agency formed under the leadership of General Royal Lord to advise the Argentine government on its 5-year plan for internal development and construction.

The retirement of **Walter L. Stutz** after 35 years' service at the National Bureau of Standards has been announced. Mr. Stutz went to the bureau in 1912 and was appointed chief of the engineering instruments and mechanical appliances section in 1928. The section of which Mr. Stutz has been chief is engaged mainly in testing activities for other government agencies. Devices tested include water stream-current meters used in connection with flood control, power development, irri-

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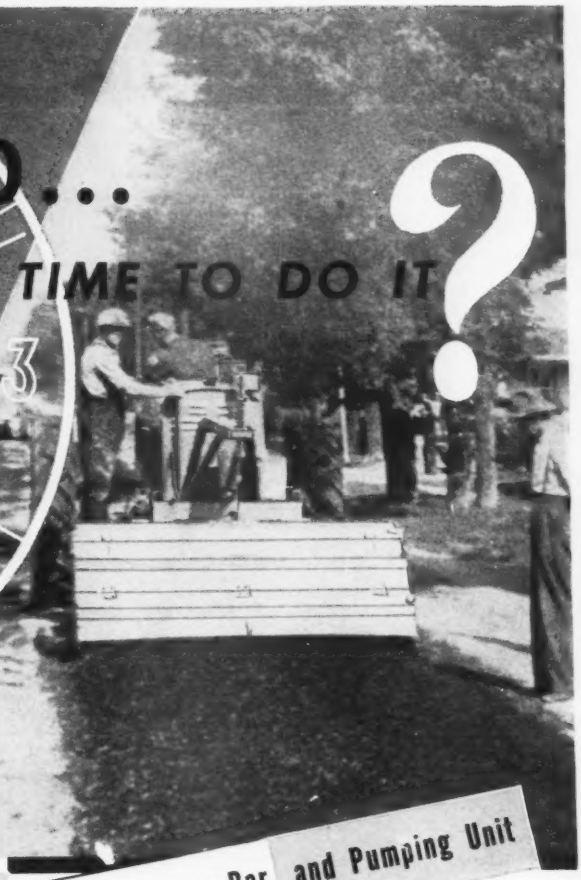

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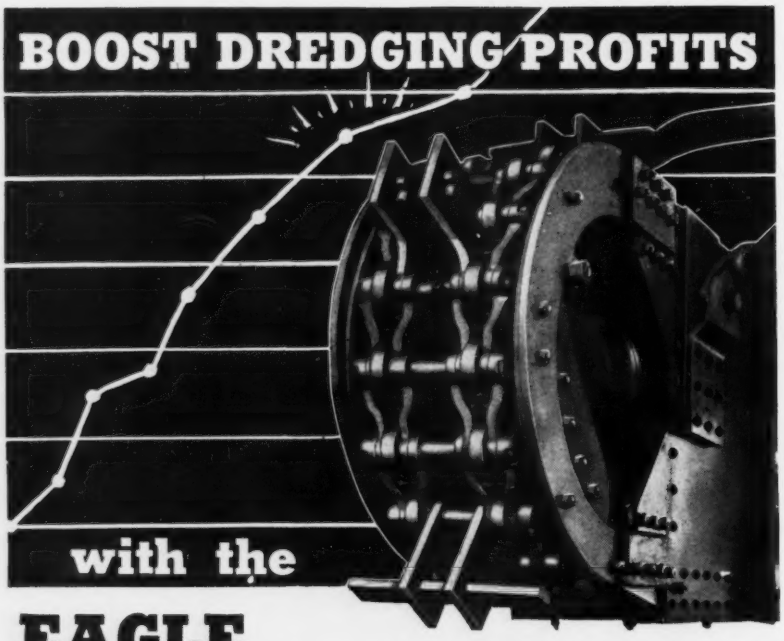

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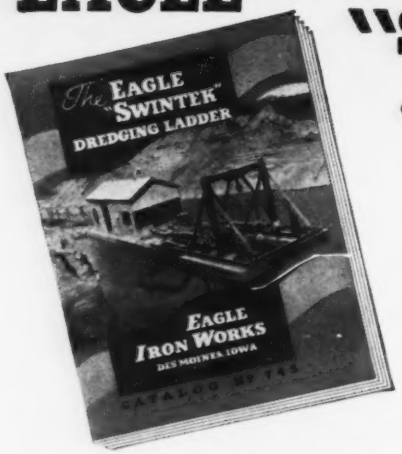

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gation, and soil conservation programs.

Walton Seymour, director of power utilization for the Tennessee Valley Authority for the last six years, has jointed the staff of Interior Secretary J. A. Krug as head of the department's new program division.

S. M. Helgeland is superintendent of public works for Fairfield, Iowa.

Lt. Col. Charles B. Schweizer, a graduate of the school of engineering at the Louisiana State University, has been named officer in charge of the Bull Shoals Dam project, it is announced by the district engineer at Little Rock, Ark.

Charles D. Curran, formerly chief of the Power and Water Resources Group of the Bureau of the Budget, is now chief of the Office of Water Control of the International Boundary and Water Commission at El Paso, Tex. A graduate of West Point, Mr. Curran first served as assistant to the district engineer, War Department, at Wilmington, N. C., and in 1929-30 was with the Nicaragua Canal Survey. Returning to the U. S. he spent two years at Cornell University followed by various Army assignments. In 1935 he joined the Massachusetts Department of Health and later was assistant director in charge of water resources studies for the Massachusetts State Planning Projects of the WPA. The following year he rejoined the Corps of Engineers and served in New York, Baltimore, Washington. He was also assistant district engineer with the flood control bureau of the Department of Forests and Waters, Commonwealth of Pennsylvania for one year. In his new position Mr. Curran will head all water control activities of the commission, including hydrographic work and hydrologic investigations. Budget matters for the commission will also be under his direction.

H. F. Faulkner, resident engineer for the second step of Ross Dam for Seattle, Wash., City Light, has retired and been succeeded by **Charles E. Shevling,** his assistant since 1943. He had retired in 1940 at the mandatory retirement age of 65, upon completion of the first step of Ross Dam, on which he was engineer in charge of concrete control. Recognized as one of the world's foremost concrete technicians, Faulkner was called back in 1943 to supervise construction of the dam's second step. He plans to accept occasional jobs as an engineering consultant. Shevling is a civil engineering graduate of the University of Washington. He was employed by the Washington State Highway Department and

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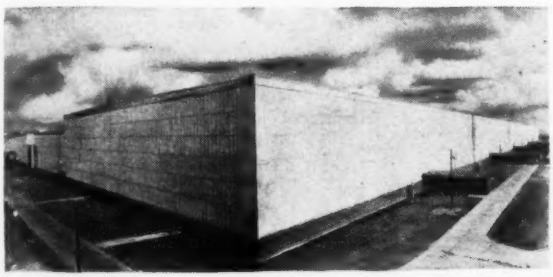

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the Seattle engineering department before joining City Light in 1934. Shevling's former position is filled by **Robert P. Sonntag,** who had been office engineer for Ross Dam since 1944. Sonntag is a civil engineering graduate of Montana State College and previously worked for the Bureau of Reclamation and Army Transport. In another Ross Dam appointment, **Henry M. Lee** was named concrete technician, in charge of the concrete laboratory and concrete control. He worked as a laboratory technician for DuPont after studying at the Drexel Institute of Technology.

Jean Vincenz, former public works director of Fresno, Calif., has been named Fresno County public works director.

Tom C. Baker has been appointed to succeed **R. D. Canfield** as engineer of Gila County, Ariz. Mr. Canfield has become resident engineer for the state highway department at Black Canyon.

Lt. Col. Paul E. LaDue of the Corps of Engineers, has been appointed resident engineer of the $16,626,000 Chain of Rocks project near S. Louis, Mo. He will supervise all construction work in the building of locks to by-pass the Chain of Rocks reach, a Mississippi River navigation hazard.

Schenk H. Kriffin, a retired Army engineer, has been engaged as chief engineer for the Metropolitan Sewer District board of Louisville, Ky.

Fred M. Davis has recently arrived in Japan as construction engineer and technical advisor to Colonel Hawkins of the First Engineering Construction Group on Kyushu Island. Among the previous overseas assignments of Mr. Davis, were two years in Puerto Rico, two years in Aruba, Netherlands West Indies and one year on the island of Guam in the Marianas. He served in the Pacific Theatre with the United States Army. He attended the Columbia Military Academy in Columbia, Tenn., and received his engineering degree at the Georgia School of Technology.

John Fies, long prominent in building code work in the Southwest, has been retained by the National Lumber Manufacturers Association to represent its technical department on the Pacific Coast. Prior to entering the Army, Mr. Fies served as chief of the division of building inspection of Dallas, Tex., and was engaged in work on building code standards. As a member of the executive committee of the Pacific Coast Building Officials Conference, and chairman of a sub-committee of

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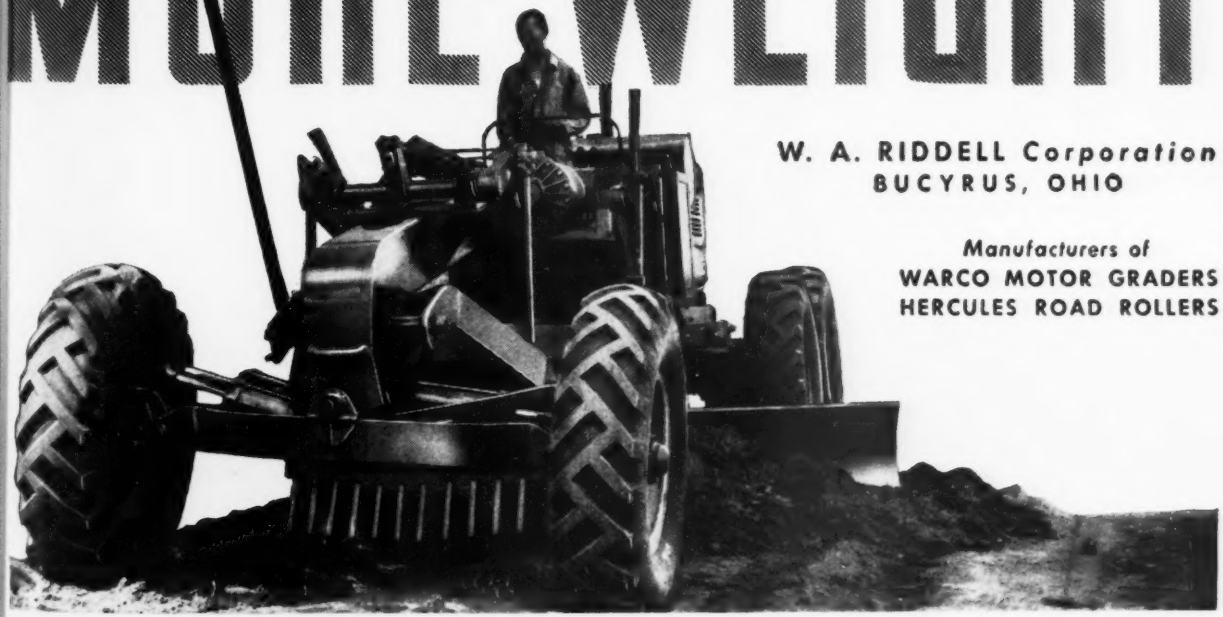

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the Building Officials Conference of America, Mr. Fies took active part in the drafting of building codes.

Raymond F. Goudey has become affiliated with Truesdail Laboratories, Inc., Los Angeles, as consulting sanitary engineer in charge of the newly formed department of the Truesdail organization which will handle chemical and engineering problems in water supply, purification and treatment, and design and operation of waste disposal processes. Mr. Gouday is a graduate of Massachusetts Institute of Technology and the University of Southern California. He was formerly in charge of the sanitary engineering division of the Los Angeles municipal department of water and power.

The retirement of **Edwin D. Burchard**, Raleigh, N. C., who has served as district engineer in charge of water surface investigations in North Carolina for the last 23 years, has been announced by the U. S. Geological Survey. He will be succeeded by **Edward B. Rice** who has been in the survey for the last 18 years, assigned to Texas, Connecticut, Alabama and Mississippi. Prior to his service in North Carolina, Mr. Burchard has been assigned in New York, Iowa and Hawaii. Mr. Rice formerly assigned in Louisiana is a graduate of Texas A. & M. College.

William R. Eaton will succeed Mr. Rice in Louisiana. He is a graduate of the University of Missouri. He entered the survey in 1929 and previously was assigned in Tennessee, Maryland, Washington, D. C., and North Carolina. His headquarters will be in Baton Rouge.

Other personnel changes include the transfer of **George E. Ferguson** from district engineer in charge of surface water investigations in Florida to a staff position in the Washington office. He has served in the survey for 19 years and has been assigned in Ohio, Texas, Hawaii, Washington, D. C., Maryland and Florida. **Archibald O. Patterson** was named to succeed Mr. Ferguson. He was graduated from the Georgia School of Technology. He entered the survey in 1930 and has had a wide experience in water investigations in Maine, West Virginia and Tennessee. His headquarters will be in Ocala.

J. Herbert McGuire is city engineer of Marshall, Mo.

Harlan Chase is engineer of Oklahoma City, Okla., succeeding Ralph Lee who will enter private practice. Don W. Hutton is city planning engineer.

R. C. Fargo is city engineer of Glasgow, Mont.

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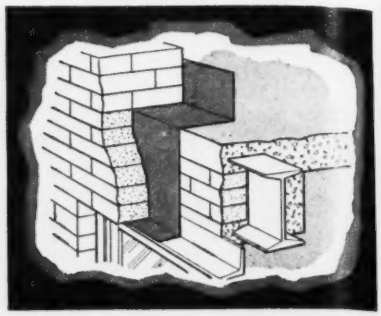

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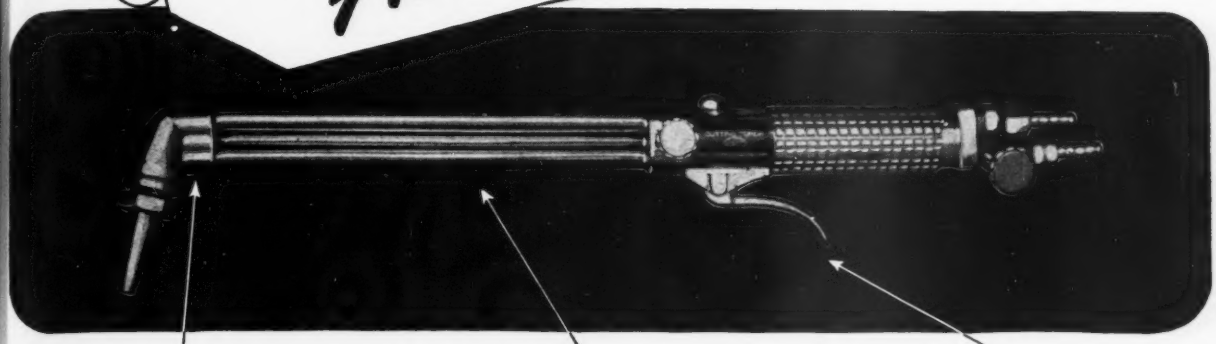

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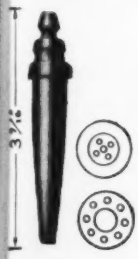

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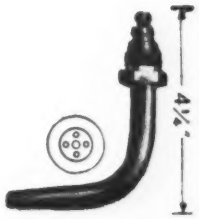

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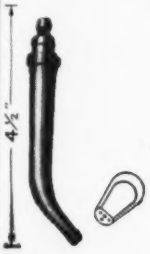

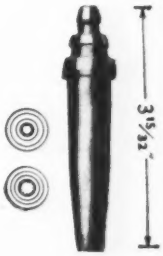

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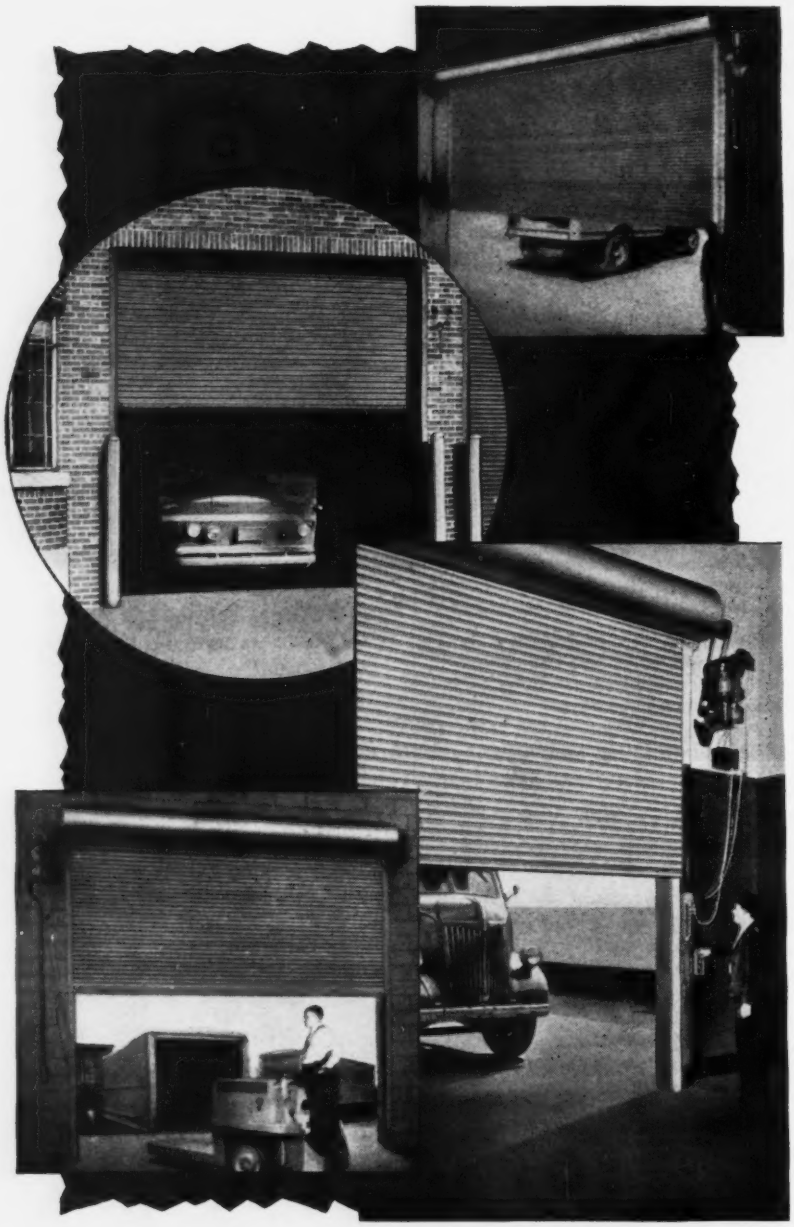

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Elections and Activities

The Associated Contractors of Montana at Helena, the second building chapter of the Associated General Contractors of America, recently received a national charter from H. E. Foreman, managing director of AGC. Don McKinnon of Helena, is the president.

The Engineering Society of Buffalo, N. Y., Inc., honored its past presidents at a recent dinner meeting. Among those honored were: George B. Bassett, Willis H. Carrier, F. Austin Lidbury, William B. Powell, Karr Parker, William J. Gamble, William T. Huber, Henry E. Riexinger, Roswell Farnham, Newell L. Nussbaumer, Gideon W. Swan, Louis A. Harding, August E. Klinger, Elwood T. Larkin, John G. Ullman, Thomas L. Mayer, Felix E. Prochnow, Robert H. McKeegan, George W. Gleasner, Clair O. Dean, Kenneth K. Koontz and Mr. Nicholls.

Dan C. Pierce, Indianapolis engineer, has been elected chairman of the Indiana Construction Industry Policy Committee for two years.

Alva R. Moses and Clarence T. Myers were elected vice-chairman and secretary-treasurer, respectively, to succeed themselves for a like period, according to S. E. Fenstermaker, president of the Construction League of Indianapolis, sponsoring agency for the committee.

Lee Philbrick, Springfield, Ill., is president, and Prof. W. M. Lansford, department of civil engineering, University of Illinois, is vice-president, of the East Central Illinois section of the ASCE with Prof. Ellis Danner, secretary-treasurer; and Prof. M. O. Schmidt, program chairman.

The election of George Johnson of Hartford as president of the Connecticut Chapter, Associated General Contractors of America has been announced. Other officers elected are: Edwin Moss of Bridgeport, vice-president; Max Teitelman of New Haven, treasurer; Earl C. Wheeler of Hartford, secretary.

Robert T. Jones, president of the Minneapolis Planning Commission for two terms, was recently re-elected unanimously for his third term. He is professor of architecture at the University of Minnesota.

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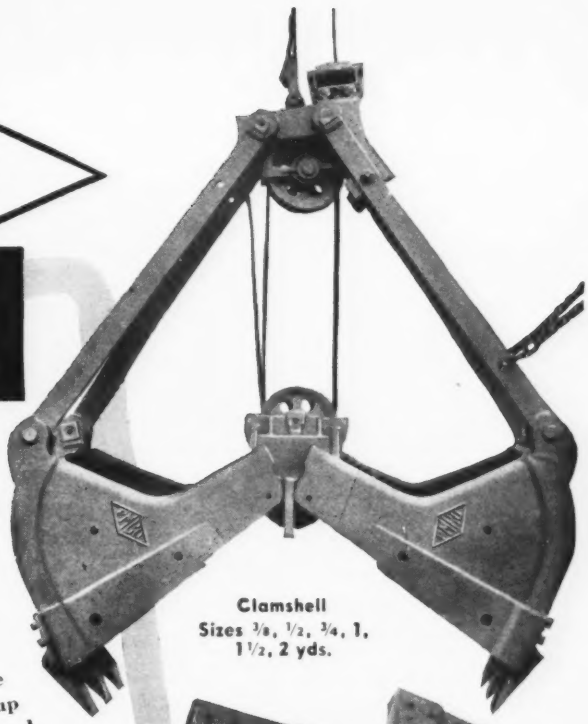

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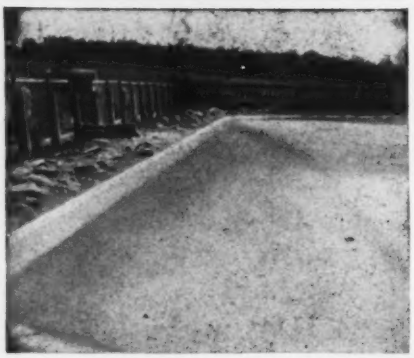
"GUNITE" CONTRACTORS
GENERAL OFFICES—ALLENTOWN, PENNA., U.S.A.



NO MAINTENANCE IN 22 YEARS

The before and after photos show a reservoir we re-lined with "GUNITE" in 1925 for the Village of East Aurora, N. Y. Recently Mr. V. E. Haemmerlein, Village Engineer, wrote us:

"The job you did of Guniting our reservoir is still in first class condition. Some hair cracks have developed near the top. I drilled one-half inch holes where some of these cracks showed but find that they are only about one inch deep. They do not go beyond reinforcing. We have had no maintenance whatsoever.

We can similarly solve your problem if you have an old leaky or disintegrated reservoir. We invite you to call on us for complete information, recommendations or estimates on any "GUNITE" work which you may be planning.

Our 72-page bulletin A2300 describes this job and scores of other profitable uses of "GUNITE." Write for your free copy today.

To increase the headwater at hydro plant, a Sauerman Slackline Cableway removes 60,000 cu. yd. of boulders and mud from 1,500-ft. section of spillway, piling spoil along bank.

SLASH YOUR DIGGING COSTS with SAUERMAN CABLEWAYS

Send for booklet showing how contractors, engineers and others are using Sauerman Cableways for a variety of jobs.

Whatever your problem of material handling, your first consideration is to keep the cost low and use as little labor as possible. When you have a contract that requires digging deep and moving material a distance of several hundred feet or more to an elevated delivery point, there is no machine equal to a Sauerman Slackline Cableway. It digs, hauls, conveys and lifts in a continuous cycle with one operator. There is a size and type of Sauerman Machine to meet your specific requirement. Low initial cost—small power consumption—inexpensive maintenance.

SAUERMAN BROS., Inc.
532 S. Clinton St. Chicago 7, Ill.

Long Range Material Handling Machines

Manufacturers' Activities

Assignment of PERMANENTE CEMENT Co. as operator of Pacific Coast Cement Co.'s Seattle plant facilities has been announced by General Construction Co., lessor of the cement plant. Permanente will manufacture cement there through February, 1948. The Seattle plant will be known as the company's Diamond division and will increase by 1,000,000 barrels Permanente's San Jose, Calif., plant production of 5,500,000 barrels annually. Gordon Tongue is manager.

BYRON JACKSON Co., Los Angeles, Calif., has announced completion of its new $1,500,000 plant for production of centrifugal pumps for industrial, municipal and agricultural use.

THE HIGHWAY Co., Zionsville, Ind., announces completion of a plant here for processing and blending Trinidad asphalt. It will serve Iowa, Missouri, Illinois, Indiana, Kentucky, Michigan, Wisconsin and Tennessee.

HARRY W. HOBSON, who started with the DuPont Company as a stenographer 44 years ago and rose to be assistant director of sales in the company's explosives department, has recently retired. George H. Loving will assume Mr. Hobson's duties as assistant director of sales, and J. A. Dallas, assistant manager of the Huntington, W. Va., sales office, will succeed Mr. Loving as assistant director in charge of chemical and miscellaneous sales.

With a demand for FRIDEN calculating machines calling for immediate expansion of plant facilities, Friden company officials in Oakland, Calif., found it necessary to construct a building where one already existed. Using knee angle truss construction, holes were cut in the roof of a building temporarily thrown up during the war. The contractor could proceed with erection of the new 411 x 75 ft. steel frame structure without upsetting production in the plant itself. Four more buildings must await release of material for completion.

Approximately 75 professors of mechanical engineering from the leading colleges in the United States have witnessed a field test run of INTERNATIONAL HARVESTOR'S Co.'s giant new TD-24 crawler tractor during a day-

What Building Material?

K & M "Century" ASBESTOS CORRUGATED

What will determine the choice of building materials for your new plant, or remodeling job?

Will it be—

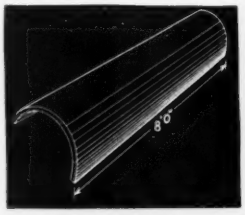
Appearance?
First cost?
Construction economy?
Speed of application?
Resistance to fire, weather, rust, other conditions?
Strength, durability?
Freedom from painting and other upkeep?

Regardless of which of those qualities you seek, K&M "Century" Asbestos Corrugated is an ideal choice, for it incorporates *all* of them in every rugged sheet. Being made of indestructible asbestos and Portland cement, it can't burn, can't rot, can't rust. Considering these many advantages, its cost is moderate, and it will pay for itself many times over in long maintenance-free life.

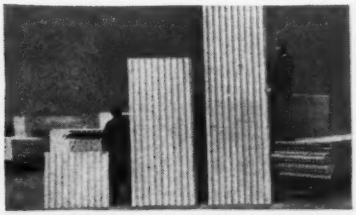
"Century" Asbestos Corrugated is easy to cut with portable electric or band saw, and easy to drill for drive screws or bolts. Cutting and fitting time is held to minimum because of 19 available sheet lengths. Salvage value is practically 100%.

If you'd like further information about "Century" Corrugated, write us, we'll be glad to help you.

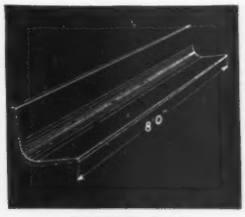
INSTALLATION DETAIL



RIDGE ROLL



VARIOUS SHEET LENGTHS AVAILABLE



CORNER ROLL

Nature made Asbestos . . .
Keasbey & Mattison has been making it serve mankind since 1873

K&M best in asbestos

Reg. U. S. Pat. Off.

KEASBEY & MATTISON COMPANY • AMBLER • PENNSYLVANIA

"STUYVESANT TOWN" uses 1½ MILLION FEET of HEL-COR PILE SHELLS

More than 1½ million feet of ARMCO Hel-Cor Pile Shells* are being used in foundation work for "Stuyvesant Town" —the huge apartment house project near the heart of New York.

It is one of the largest piling orders on record for a single construction job. About 37,500 individual piles will be used; depths range to 75 feet.

When this project is completed, "Stuyvesant Town" will be a city within a city. It is estimated that 35,000 persons will be housed in its modern buildings.

These are some of the reasons why ARMCO Hel-Cor Pile Shells were chosen for this important job: They are easily handled, light in weight, and exceptionally straight. By torch cutting and field welding salvaged lengths can readily be used.

For complete information about ARMCO Pile Shells for construction work, write Armco Drainage & Metal Products, Inc., 3555 Curtis Street, Middletown, Ohio.

**Armco Hel-Cor Pile Shells being installed at "Stuyvesant Town" by Western Concrete Pile Corp.*

ARMCO

ARMCO PILE SHELLS

long session at the company's diesel engineering facilities in Chicago. Considerable interest was focused on the engine of the new 36,000-pound T-23 tractor because of its vast horsepower capacity for tractor use and the significance it will have on future development of similar engines.

INDUSTRIAL MODELS, Arden, Wilmington, Del., is a new company formed of engineers with design experience to produce scale models of industrial plants; the models are complete, including buildings, equipment and piping.

LEONARD A. HENDRICKSON has been appointed as midwest regional representative of Clyde Iron Works, Inc., with headquarters at Chicago. John Van Zandt has been transferred to the home office at Duluth.

The following appointments have been made by the DAVEY COMPRESSOR Co., Kent, Ohio: Fly & Harwood, Inc., Memphis, Tenn., as distributors of Davey compressors; S. J. Reed Co., Portland, Me., complete line. Cal.-Ore. Machinery Co., Medford, Ore., will handle Davey portable compressors.

Detroit diesel engine division, GENERAL MOTORS CORP., has announced the appointment of Royce A. Hill as field sales engineer in the Dallas region. Mr. Hill will be responsible for all industrial and petroleum distributor's sales activities for Oklahoma, northern Texas and northern New Mexico.

THE CLIPPER MANUFACTURING CO., makers of Clipper masonry saws, portable hoists and superior blades, announce the opening of a branch office at 208 Noble Court, Cleveland 13, Ohio. This new factory, warehouse and office will carry a complete stock. William E. Davis is district manager and Robert M. Stubbs office manager.

WILLIAM E. CLARK, general manager of Dravo Corp.'s Keystone division, has been elected a vice president of the corporation at Pittsburgh.

Roy E. McCluskey, assistant treasurer of R. G. LETOURNEAU, INC., Peoria, Ill., has been made vice president in charge of sales and related departments. Robert F. Nelson has resigned as vice president and assistant to the president, but is continuing his affiliation with the LeTourneau interests as a member of the board of directors.

U. S. STEEL SUPPLY CO., Chicago, Ill., a subsidiary of U. S. Steel Corp., will extend its operations to the west coast with a warehouse in Los Angeles. Clif-

THIS VERSATILITY

is exclusively

ADNUN

The Adnun is more than a black top paver. It brings you a flexibility impossible with any other black top paver.

You may be on a hot job today, a cold job tomorrow, or you may have to lay stone, soil cement or stabilized base the day after. The Adnun handles them all, leaving a smooth level course with clean edges. The overlapping cutter bar carries the material of the parallel course up to the joint, making the joint tight under pressure.

Maneuverability is easy and fast, saving time on return trips when starting a second course or parallel course. By means of the Adnun Carryall, which is easily attached, the Adnun can travel practically free and go almost anywhere.

Don't tie yourself down to a "one job" machine. Let us send you complete details.

THE FOOTE COMPANY, INC.
1922 State Street — Nunda, New York

Above — Laying 1½ in. stone on an airport taxi strip job.

Below — Rolling away to lay parallel course. The Adnun Carryall speeds up the job.

ADNUN

TRADE MARK REGISTERED

BLACK TOP PAVER

Builders of **Adnun Black Top Pavers, MultiFoote Concrete Pavers and Foote Kinetic Mixers**

Maximum returns on big dragline investments are dependent upon getting the best bucket available and using it correctly.

Page Automatics dig right in at the first pull on the load line because they always land in digging position and hold it even with all lines slack. Instant penetration at any depth, 20 feet to 100 feet — or more, assures full loads in any kind of digging in less than two bucket lengths. Perfect balance of the bucket helps the digging action. Teeth cannot be lifted off the ground by the pull line. For details send for Bulletin 1537.

New Page Reversible Center Shank Tooth Points secured by a hook bolt will stay absolutely tight.

PAGE *Automatic*

DRAGLINE BUCKETS *and* WALKING DRAGLINES

PAGE ENGINEERING CO., CHICAGO 38, ILLINOIS

PREHY GROUTERS— WEBER SYSTEM

New indispensable Equipment for Contractors, Railroads, Mines and all public and private Construction Departments.

Plastic and Fluid Pressure Grouting, Pneumatic Concrete Construction, Railway Track and Soil Stabilization, Correction of Structural Deficiencies, Subsiding Foundations, Floors, Drypack Concrete and many other practical uses.

Write for complete information

The Prehy Co., Inc. 420 LEXINGTON AVE NEW YORK 17, U.S.A.

ford W. Lord is appointed manager. With a warehouse at 2087 E. Slauson St., U. S. Steel Supply will carry a complete line of steel and allied products.

THE CHICAGO PNEUMATIC TOOL CO. of New York now has a branch office at 528 11th St., Rock Island, Ill. It will be under the jurisdiction of the Chicago district office, of which G. C. VandenBoom is district manager. J. C. Wisner and A. B. Rudstrom will handle sales and service in the Rock Island office.

CANVAS PRODUCTS CO. has changed its name to indicate its increased scope of operations. It is now known as CANVAS FABRICATORS, INC. 651 W. Fulton St., Chicago 6, Ill. Products include tarpaulins and canvas materials of all types.

SOLVAY SALES CORP., New York, has announced that the New Orleans and Houston branch offices have moved into new quarters. The former is at 1107 Pere Marquette Bldg., Baronne St., New Orleans 12, La. and the latter is at 1313 City National Bank Bldg., 921 Main St., Houston 2, Tex.

THE GYPSUM ASSOCIATION has opened a Pacific Coast division office in the Architects Bldg., 816 West 5th St., Los Angeles, with Henry J. Schweim as secretary-manager. The new division services California, Arizona, Utah, Nevada, Idaho, Oregon, Washington, and the western half of Montana.

AMERICAN TRACTOR EQUIPMENT CORP., Oakland, Calif., announces the appointment of Howard-Cooper Corp. as distributor in Oregon and western Washington for ATECO 2-wheel and 4-wheel scrapers for use with wheel and track type tractors.

SOULE' EQUIPMENT CO., Oakland, Calif., has been appointed a distributor in northern California for the full line of Schramm compressors and will provide both sales and rental service.

Establishment of the MASOLITE CO., a division of the General Dredging Co., Fort Wayne, Ind., has been announced. The new company will make concrete brick, concrete block, and Masolite block. It will employ approximately 100 at peak production in their plant at 220 LaFontain St.

WALTER E. JUBIEN, recently of the French Supply Council, Washington, D. C., has become associated with the Barium Steel Corp. He will assist in the further development of the export sales of products of Barium subsidiaries which include Clyde Iron Works and

Laying rectified photographs to assemble a closely controlled Fairchild photomap or mosaic

planned approach means *useful* maps

. . . for better management and engineering

FIRST THINGS FIRST. The survey will be practical and economical only if the preliminary plan is right. Good planning means balancing the kind of map with the requirements of the project at hand. This is a Fairchild service that will save you money. It's a service that makes full use of the simpler and better ways of doing a job.

EXPERIENCE IS WHAT COUNTS—experience in the complexities of aerial photogrammetry—experience in developing the right plan where it's needed. Fairchild has that experience. Fairchild clients have expressed much satisfaction with the way in which Fairchild engineers have organized and conducted their surveys.

WHEN PLANNING A SURVEY, use the Fairchild preliminary consultation service, for which there is no fee.

For Industry, Commerce and Public Works

Since 1920, Fairchild has served clients the world over . . . conducting domestic and expeditionary aerial surveys in the fields of:

Petroleum	Highways	Taxation
Mining	Railroads	Harbors
Geology	Traffic	Flood Control
Forestry	Utilities	City Planning
Water Ways	Pipe Lines	Legal Evidence

Fairchild AERIAL SURVEYS, INC.

Photogrammetric Engineers

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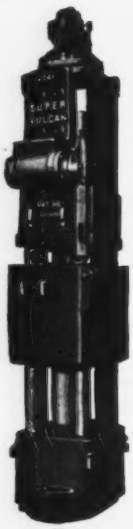
PENETRATING POWER

SUPER-VULCAN
OPEN TYPE
DIFFERENTIAL-ACTING
PILE HAMMERS
18C, 30C, 50C and 80C

● Brute force and speed backs every powerful Super-Vulcan blow to drive piles faster, easier, at less cost, with 25 to 35 per cent less steam per blow.

Rugged strength, simple design, positive action, durability and compactness are the basis for Super - Vulcan's efficiency, dependable performance and lasting service. The open type Super-Vulcan fits the same leads and uses the same accessories as the Vulcan Single - Acting Pile Hammer.

Find out about the super performance of Super-Vulcan — the pile hammer that delivers twice the usual number of blows per minute. Write today for full details.



Sizes
18C—30C—50C—80C
meet all needs

VULCAN IRON WORKS
Since 1852
331 North Bell Avenue
Chicago 12 ---Illinois

Wiley Equipment Co. in the construction field.

VERNON W. BARLOW, a civil engineer, of St. Louis, Mo., was recently appointed general sales manager of the Monarch Cement Co., at Humboldt, Kans. He will direct sales activities in an eight-state region.

SELBY F. GREER has been appointed general sales manager for the Kellogg division of American Brake Shoe Co. Kellogg's principal products are air compressors and paint spray equipment. H. O. Holland, vice-president and former general sales manager, will assume new duties.

A building materials installation school has been established by the building materials division of the ARMSTRONG CORK CO., Lancaster, Pa., and will be used for the training of salesmen and the development of trained installation mechanics.

A new product service division has been announced by the A. O. SMITH CORP., of Milwaukee, Wis. The new service facilities will begin to function immediately for the company's glass-lined water heaters, coal stokers, welding equipment, electric motors, pumps, and meters.

Appointment of CHESTER L. JONES, JR., as sales manager of Monsanto, Chemical Co.'s protective coatings department was announced by the company's Merrimac division.

David S. Betcone, long associated with the development of markets for Douglas fir plywood, has established a new firm, ENGINEERED PLYWOOD PRODUCTS CO., Tacoma, Wash., to supply industrial panel users with plywood and veneer cut to size and pattern.

W. & L. E. GURLEY, of Troy, N. Y., century-old manufacturers of engineering instruments, has enlarged its reticle-making department to contract-manufacture glass reticles for all types of optical measuring instruments.

HAROLD C. CLARK, head of the road machinery division of Cleaver-Brooks Co., has joined the Rosco Manufacturing Co. of Minneapolis, Minn. He will have complete charge of all sales east of the Mississippi River.

The appointment of JOHN MCSHAIN as Macmillian Petroleum Corp. distributor for Philadelphia, has been announced. The new company, known as the Macmillan Oil Distributors of Philadelphia, will be under the direct supervision of Richard Schwoerer.

PROMPT DELIVERY
HAUCK
Oil Burning
Heating & Melting
Equipment
Get Ready Now!

- Melting Kettles for Tar · Asphalt · Bitumen
- Torch Burners for Heating and Thawing
- Compound Melt. Furnaces
- Lead Melting Furnaces
- Asphalt Surface Heaters
- Asphalt Tool Heaters
- Concrete Heaters
- Steam Generators
- Water Heaters
- Salamanders

Write for Catalog

HAUCK MANUFACTURING CO.
150-160 Tenth St. • Brooklyn 15, N. Y.

PRESSURE CONCRETE RESTORATION at Y and E

DISINTEGRATED CONCRETE WAS FIRST COMPLETELY REMOVED BY PNEUMATIC HAMMER

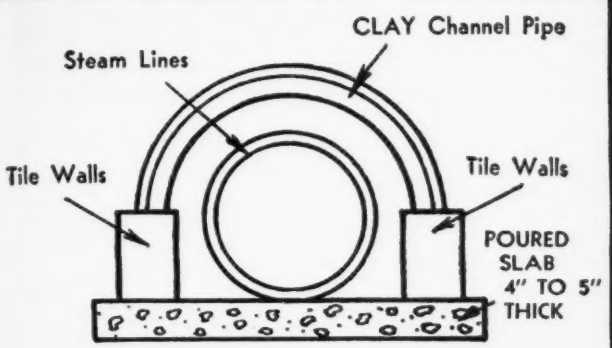
NOW COMPLETELY RESTORED BY PRESSURE CONCRETE - (BEFORE APPLICATION OF PROTECTIVE COAT)

The Y and E plant at Rochester, N. Y. is but one of the many organizations using the PRESSURE CONCRETE method of Hudson-Rumsey Co., Inc. for building maintenance.

Send for FREE BOOKLET on CONCRETE RESTORATION.

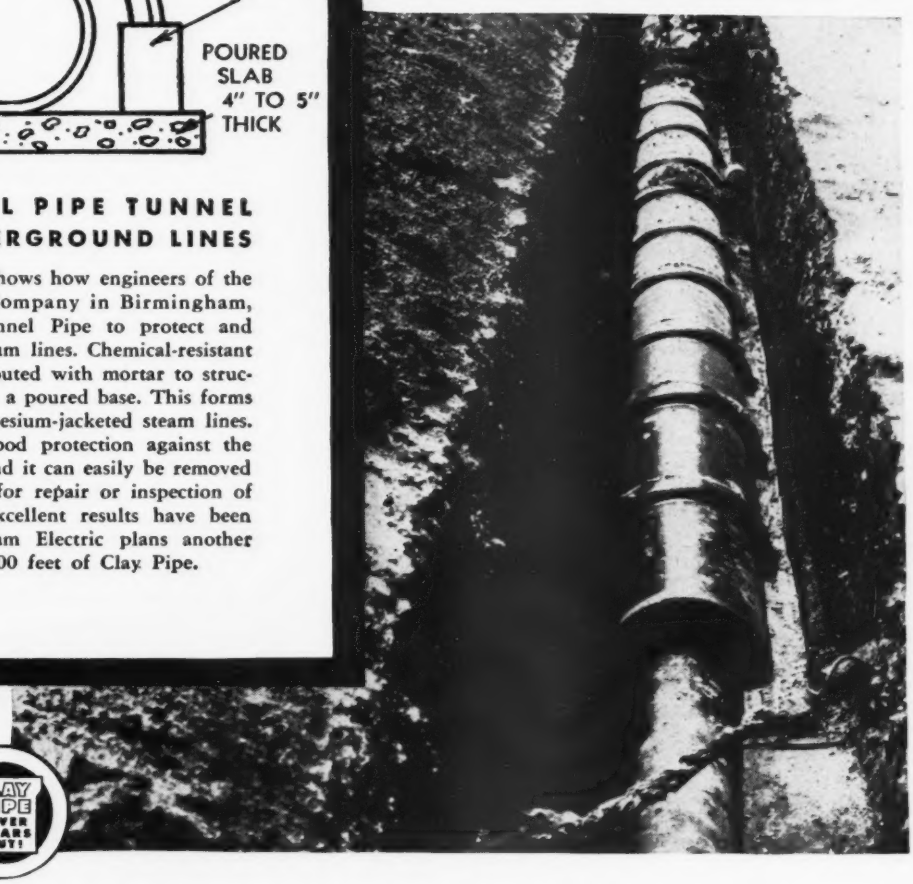
HUDSON-RUMSEY CO. INC.
1200 NIAGARA ST. BUFFALO, N. Y.

ENGINEERS DISCOVER NEW USES FOR CLAY PIPE



CLAY CHANNEL PIPE TUNNEL PROTECTS UNDERGROUND LINES

Cross-sectional diagram shows how engineers of the Birmingham Electric Company in Birmingham, Alabama use Clay Channel Pipe to protect and insulate underground steam lines. Chemical-resistant Clay Channel Pipe is grouted with mortar to structural tile sidewalls set on a poured base. This forms a "tunnel" for the magnesium-jacketed steam lines. The Clay Pipe offers good protection against the dampness of the earth, and it can easily be removed to provide quick access for repair or inspection of the steam lines. Such excellent results have been obtained that Birmingham Electric plans another similar installation of 2800 feet of Clay Pipe.

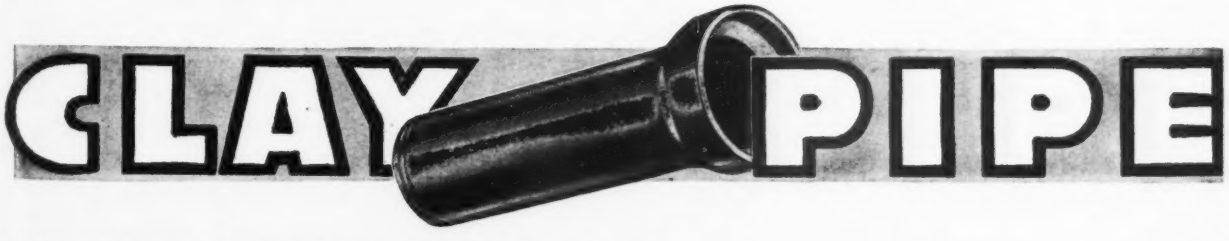


CLAY PIPE NEVER WEARS OUT!

THE same durability and corrosion-resistance that have made Clay Pipe the traditional material for all types of sewerage installations is winning wide approval in solving new and different problems. Engineers find Clay Pipe ideal insulation and protection for underground steam lines. Also, Clay Pipe is being used throughout the chemical industry to carry fluids that would soon destroy most other pipes. Clay Pipe is an economical and durable material for ducts that carry off strong industrial fumes. Clay Pipe is especially useful for drainage of modern highways and airports where heavy loads must be supported safely. For information about your Clay Pipe problems, write to the nearest regional office listed below.

NATIONAL CLAY PIPE MANUFACTURERS, INC.

111 W. Washington St., Chicago 2, Ill.
522 First National Bank Bldg., Atlanta 3, Ga.
1105 Huntington Bank Bldg., Columbus 15, Ohio
571 Chamber of Commerce Bldg., Los Angeles 15, Calif. C-947-A



LOWEST P.F.P.Y.* COST ON RECORD

THANKS TO *Terrazzo*

These stairs will *last* . . . as long as the building does. That's why the P. F. P. Y.* cost is so low. Marble-hard, concrete-durable terrazzo is the closest thing to erosion proof available to the builder today.

But terrazzo's benefits extend beyond durability. Requiring no refinishing, no painting, no costly repairs—being easy to keep clean—these aren't its only virtues. Terrazzo is versatile. Designs and colors are as unlimited as your imagination. Specify terrazzo for floors, wainscots, stairs, and walls—and do your client a permanent service.

* PER FOOT PER YEAR

For free AIA Kit, a complete reference work about TERRAZZO, the once-in-a-lifetime floor — write

THE NATIONAL TERRAZZO AND MOSAIC ASSOCIATION, INC.
1420 New York Avenue, N. W. Dept. E Washington 5, D. C.

WELDING CONNECTORS
Saxe System Welded Connection Units for welded assembly

Saxe Units place in position and securely hold together structural parts to be welded.

As used in many welded structures they *eliminate all hole punching*, producing an economical, rigid, safe and quickly erected structural frame.

Write for descriptive literature

J. H. WILLIAMS & COMPANY
Buffalo-7, New York
G. D. PETERS CO., Montreal-2, Canada
Canadian Representatives

THE MOUNT VERNON BRIDGE CO.
Engineers Contractors
STRUCTURAL STEEL
RAILWAY AND HIGHWAY BRIDGES
BUILDINGS AND VIADUCTS
MOUNT VERNON OHIO

Manufacturers' Publications

Solar Transit—A 20-page bulletin describes the construction, operation and usefulness of the Gurley telescopic solar transit in land surveying. Designed for speed and accuracy of instrumental orientation, the solar transit is useful in preliminary surveys of all kinds, exploration and reconnaissance surveys, ground control for air photos, right-of-way, timber and oil-field surveys where normally considerable cutting would be necessary to remove obstructions to survey lines. Pamphlet contains the theory of instrumental orientation by use of the solar attachment. Inasmuch as textbooks on surveying have not, up to this time, given deserved attention to this type of solar units, the many explanations have been written explicitly for student instruction and to guide actual use.—*W. & L. E. Gurley, Troy, N. Y.*

Earthmoving Equipment—(23x33-in. broadside) Explains in detail and pictures design features built into a new self-loading D Tournapull. Large-size, job-action photographs show how it can be used on small yardage projects. Inside spread gives complete specifications on this one-man-operated rig. —*R. G. LeTourneau, Inc., Peoria, Ill.*

Control Switch—(12-p. bulletin) Describes Type SB-1 control and transfer switch for opening, closing and transferring low-capacity circuits up to 20 amp. at 600 v. a.c. or d.c. Photographs and exploded views show construction of switch, both for single-stack and tandem units.—*General Electric Co., Schenectady, N. Y.*

Nickel Alloys — (Handbook and guide) Includes information on nickel, Monel, Inconel and associated alloys, as well as such other alloys as Hastelloys and Illium. Written by Dr. Norman E. Woldman, consulting metallurgical engineer, it reports on properties, heat and corrosion resistance, as well as on modern fabrication and finishing practices.—*International Nickel Co., Inc., 67 Wall St., New York 5, N. Y.*

Engineering Progress—(32-p. annual review) Covers all phases of company's activity during 1946, including section on construction and public works.—*Allis-Chalmers Manufacturing Co., Box 512, Milwaukee 1, Wis.*